**Master of Science in Engineering**

**The University of Rajshahi**

**Faculty of Engineering**

**Department of Materials Science and Engineering**

**Curriculum for M. Sc. Engineering**

**Session: 2022-2023**



**Examination**

**M. Sc. Engineering 1st Semester 2022**

**M. Sc. Engineering 2nd Semester 2023**

**M. Sc. Engineering 3rd Semester 2023**

**Master of Science in Engineering**

**The University of Rajshahi**

**Vision of the University:**

To pursue enlightenment and creativity for producing world-class human resources to cater for the needs of changing time.

**Mission of the University:**

1. To ensure a world-class curriculum with talented academicians and conducive academic and research environment for generation and dissemination of knowledge.
2. To maintain international standards in education with focus on both knowledge and skills, and humanitarian and ethical values to meet the needs of the society and state.
3. To develop strategic partnerships with leading national and international universities, and organizations for academic as well as research collaborations.

**Department of Materials Science and Engineering**

**Faculty of Engineering**

**Vision**

Is to be a center of education and research to create innovative engineers who can meet the global challenges of Tomorrow’s Materials Science and Engineering arena.

**Mission**

To achieve the vision, we want to

1. Cultivate students with a vibrant engineering education and prepare them with future outlook.
2. Promote cutting-edge materials based interdisciplinary research to figure out sustainable solution for national and global problems.
3. Develop new material, design or technology with focus on 'Make in Bangladesh' and `Future Today` concept.
4. Nourish leadership role of the students to be compatible for multi-disciplinary materials community.

**Objectives of the Program Offering Entity (POE)**

Materials Science and Engineering is one of the most important, lucrative and utility subject of modern science. Nowadays, the subject is considered as the barometer of the development of a country. The objectives of Materials Science and Engineering department is to create skilled engineers who can deal with the processing, designing, characterizing the materials, develop new materials, produce cost effective materials and apply the materials in structures, machines and devices of technological importance.

**Name of the Degree:** Master of Science in Engineering in Materials Science and Engineering

**Description of the Program:**

The M. Sc.Engg. Program in Materials Science and Engineering shall have a minimum duration of three semesters of 6 (six) months each. The duration of M. Sc.Engg. program shall be of 78 weeks, where first semester, second semester and third semester shall be of 19 weeks, 19 weeks and 26 weeks, respectively. A candidate for the M. Sc.Engg. Degree must complete all requirements for the degree within **three and half** academic years from the date of his/her first admission. A student shall be required to have attended at least 70% of the total number of lectures/tutorials/laboratory classes held to appear as a regular candidate at the semester final examinations.

**Program Educational Objectives (PEOs)**

After completing the MS/MSc Eng. Program from the Dept. of MSE RU the students will

1. Be compatible to conduct research to solve any kind of problem related to MSE and thus help the human kind.
2. Be able to catch the market demand of a material so that they can either modify an existing material or can design and develop a new material.
3. Be able to create a new process or modify an existing process to minimize the materials production cost and problems.

**Program Learning Outcomes (PLOs)**

After completion of the M.Sc. Engineering in Materials Science and Engineering program graduates will be able to

|  |  |
| --- | --- |
| **PLO-1** | **Design/development of solutions:**Design systems, components, processes or a new material to solve a complex engineering problem that meet specified needs with appropriate consideration for public health, and safety, cultural, societal and environmental considerations. |
| **PLO-2** | **Investigation:**Conduct investigations of complex problems using research-based knowledge of materials science and engineering to search new methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. |
| **PLO-3** | **Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex materials engineering problems. |
| **PLO-4** | **Environment and sustainability:**Understand and evaluate the sustainability and impact of a new material or technology while solving complex engineering problems in societal and environmental contexts. |
| **PLO-5** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. |
| **PLO-6** | **Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work as a member and leader in a team, to manage projects and in multi-disciplinary environments. |
| **PLO-7** | **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in, independent and life-long learning in the broadest context of technological change. |

**Mapping mission of the University with PEOs**

|  |  |  |  |
| --- | --- | --- | --- |
| **PEOs** | **Mission 1** | **Mission 2** | **Mission 3** |
| **PEO 1** | **√** | **√** |  |
| **PEO 2** |  |  | **√** |
| **PEO 3** |  | **√** | **√** |

**Mapping PLOs with the PEOs**

|  |  |  |  |
| --- | --- | --- | --- |
| **PLOs** | **PEO 1** | **PEO 2** | **PEO 3** |
| **PLO 1** | **√** | **√** | **√** |
| **PLO 2** | **√** | **√** | **√** |
| **PLO 3** |  |  | **√** |
| **PLO 4** | **√** |  |  |
| **PLO 5** | **√** |  |  |
| **PLO 6** |  | **√** |  |
| **PLO 7** | **√** |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course No.** | **Course Title** | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** |
| MSE M1111 | Advanced Engineering Materials | **√** | **√** |  |  |  |  | **√** |
| MSE M1121 | Nanotechnology | **√** | **√** |  | **√** |  |  | **√** |
| MSE M1131 | Engineering of Textile Materials |  | **√** |  | **√** |  |  | **√** |
| MSE M1141 | Thin Films |  | **√** |  | **√** |  |  | **√** |
| MSE M1181 | Extractive Metallurgy | **√** | **√** | **√** |  |  |  |  |
| MSE M2111 | Optoelectronic Materials and Devices | **√** | **√** |  |  |  |  | **√** |
| MSE M2121 | Nuclear Engineering | **√** | **√** |  | **√** |  |  | **√** |
| MSE M2131 | Functional Polymers | **√** | **√** |  | **√** |  |  | **√** |
| MSE M2141 | Biomaterials | **√** | **√** |  | **√** |  |  | **√** |
| MSE M2110 | Board Viva-voce |  |  |  |  |  |  |  |
| MSE M3112 | Thesis |  |  | **√** |  | **√** |  | **√** |
| MSE M3110 | Thesis Viva-voce |  |  |  |  |  |  |  |

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| **Structure of the Curriculum** |
|  | **1.** | **Duration of the Program and Course Structure:**  |
|  |  | **1.1** | The minimum duration of the M. Sc.Engg. program shall be three semesters of 6 (six) months each. A candidate for the M. Sc. Engg. Degree must complete all requirements for the degree with in three and half academic years from the date of his/her first admission. |
|  |  | **1.2** | Teaching for the courses is reckoned in terms of credits within the following guidelines: |
|  |  |  |  | **Nature of course** | **Contact hour (for 1 credit)** |  |
|  |  |  |  | Theoretical Lecture | :1 hour a week |  |
|  |  |  |  | Thesis | :3 hours a week |  |
|  |  |  |  |  |  |  |
|  |  |  | For other fractions of credit, proportionality shall be applied. |
|  |  | **1.3** | **Total Hours/week:** The total teaching hours including lecture, tutorial and laboratory shall be between 24 - 42 hours per week. |
|  | **2.** | **Academic Calendar** |
|  |  | **2.1** | The minimum duration of the M. Sc. Engg. Programme shall be three semesters, duration of each semester shall be **not less than 13 teaching weeks.** |
|  |  | **2.2** | There shall be final examination at the end of each semester conducted by the Examination Committee which shall be formed by the academic committee of the Department. |
|  |  | **2.3** | **Academic schedule** for general notification shall be published before the start of the 1stsemester, on approval of the Department Academic Committee. The schedule may be prepared according to the following guidelines: |
|  |  |  |  | **1stSemester (19 weeks)** | **Number of weeks** |  |
|  |  |  |  | Teaching | 13 weeks |  |
|  |  |  |  | Preparatory Leave | 2 |  |
|  |  |  |  | Examination Period | 2 |  |
|  |  |  |  | Result Publication | 2 |  |
|  |  |  |  | **Total:** | 19 |  |
|  |  |  |  |  |  |  |
|  |  |  |  | Vacation including Inter-Semester Recess | 1 week |  |
|  |  |  |  | **2ndSemester (20 weeks)** | **Number of weeks** |  |
|  |  |  |  | Teaching | 13 weeks |  |
|  |  |  |  | Preparatory Leave | 2 |  |
|  |  |  |  | Examination Period | 2-3 |  |
|  |  |  |  | Result Publication | 2-3 |  |
|  |  |  |  | **Total:** | **20** |  |
|  |  |  |  |  |  |  |
|  |  |  |  | Vacation (Summer, Ramadan, and Others) Including Inter-Session Break. | 12 weeks |  |
|  |  |  |  | **(1st Semester+2nd Semester) Total:** | **52 weeks** |  |
|  |  |  |  |  |  |  |
|  |  |  |  | **3rd Semester (26 weeks)** | **Number of weeks** |  |
|  |  |  |  | Teaching | 13 weeks |  |
|  |  |  |  | Preparatory Leave | 2 |  |
|  |  |  |  | Examination Period | 3-4 |  |
|  |  |  |  | Result Publication | 7-8 |  |
|  |  |  |  | **Total:** | **26** |  |
|  |  |  |  |  |  |  |
|  |  |  |  | **(1st Semester+2nd Semester+3rd Semester) Total:** | **78 weeks** |  |
|  |  |  |  |
|  | **3.** | **Admission Requirements:** |
|  |  | **3.1** | For admission into the M. Sc. Engg. program, a candidate must have a B. Sc. Engineering/B.Sc. Honours or an equivalent degree in Materials Science and Engineering/related subject with good academic records from any recognized Institute/University. The admission criteria for the other students than Rajshahi University will be defined by the academic committee. |
|  |  | **3.2** | Maximum two years break of study after passing B. Sc. Engineering/B. Sc. Honours or equivalent degree can be allowed for admission. |
|  |  | **3.3** | Every registered student shall get himself/herself enrolled on payment of prescribed fees and other dues before the commencement of each semester. |
|  |  | **3.4** | Eligibility for the admission of foreign students in the aforementioned postgraduate programme will be examined by the equivalence committee formed by the Faculty of Engineering. |
|  | **4.** | **Attendance** |
|  |  | **4.1** | In order to be eligible for appearing at the semester final examination as a regular candidate, a student shall be required to have attended at least 70% of the total number of lectures/tutorials/laboratory classes held in the semester. The laboratory courses mean all laboratory/project/field work/in-plant training or similar courses. |
|  |  | **4.2** | A student whose attendance is 60% to less than 70% may be allowed to appear at the final examinations as an irregular student but **he/sheshall not be eligible for any scholarship or stipend.** |
|  |  | **4.3** | Student having **less than 60% attendance will not be allowed to appear** at the final examinations of the semester. |
|  |  | **4.4** | The concerned course teacher shall prepare an attendance report of the students. The report will be submitted to the **Chairman** of the Department within **three days** of the last class of the course. Awarded marks for class attendance of the students shall be also prepared by the concerned course teacher and submitted to the Chairman of the Examination Committee and Controller of Examination of Rajshahi University in a sealed cover. |
|  |  | **4.5** | The percentage of attendance of the readmitted students shall be counted from the date of the start of the semester or from his/her previous attendance of the semester. |
|  | **5.** | **Striking off the Names and Readmission** |
|  |  | **5.1** | The names of the students shall be struck off and removed from the rolls on the following grounds: |
|  |  |  | 5.1.1 | Non-payment of University fees and dues within the prescribed period, |
|  |  |  | 5.1.2 | Failing to get himself/herself promoted to the next higher semester, |
|  |  |  | 5.1.3 | Forced to discontinue his/her studies under disciplinary rules, |
|  |  |  | 5.1.4 | Withdrawal of names from the rolls of the University on grounds acceptable to the Vice-Chancellor of the University after having cleared all dues. |
|  |  | **5.2** | In case a student, whose name has been struck off the rolls under clause 5.1.1 seeks readmission **before the start of the next semester** he/she shall be readmitted on payment of all the fees and dues. But if he/she seeks readmission in any subsequent **semester**, the procedure for his/her readmission will be the same as described under **clause 5.4** below. |
|  |  | **5.3** | In case a student, whose name has been struck off the rolls under clause 5.1.2 seeks readmission **before the start of the next semester** he/she shall be readmitted on the approval of the relevant department on payment of all the arrear fees and dues. |
|  |  | **5.4** | A Student, whose name has been struck off the rolls by exercise of the clause 5.1.3, seeking readmission after expiry of the suspension period, shall submit an application to the Chairman of the Department before the commencement of the semester to which he/she seeks readmission. The Chairman of the Department shall forward the application to the Vice-Chancellor. In case the readmission is allowed, the student will be readmitted on payment of all the fees and dues within one week from the date of permission given by the Vice-Chancellor. |
|  |  | **5.5** | In case of any application for readmission is rejected, the student may appeal to the Academic Council for re-consideration. **The decision of the Academic Council shall be final.** |
|  |  | **5.6** | No student who has withdrawn his/her name under clause (i.4) shall be given readmission. |
|  |  | **5.7** | All readmission should preferably be completed before the semester starts. |
|  |  | **5.8** | The application of a student for readmission will only be considered if he/she applies within **one year** from the date he/she discontinued his/her studies in the University. **The maximum period of studies** for M.Engg. degree under **no circumstances will exceed three and half academic years.** |
|  | **6.** | **Grading System** |
|  |  | **6.1** | Thelettergradesystemforassessingtheperformanceofthestudentsshallbeas follows: |
|  |  |  |  | **Numerical grade** | **Letter Grade (LG)** | **Grade Point (GP)** |  |
|  |  |  |  | 80% or above | A+ | 4.0 |  |
|  |  |  |  | 75% to less than 80% | A | 3.75 |  |
|  |  |  |  | 70% to less than 75% | A- | 3.5 |  |
|  |  |  |  | 65% to less than 70% | B+ | 3.25 |  |
|  |  |  |  | 60% to less than 65% | B | 3.0 |  |
|  |  |  |  | 55% to less than 60% | B- | 2.75 |  |
|  |  |  |  | 50% to less than 55% | C+ | 2.5 |  |
|  |  |  |  | 45% to less than 50% | C | 2.25 |  |
|  |  |  |  | 40% to less than 45% | D | 2.0 |  |
|  |  |  |  | Less than 40% | F | 0.0 |  |
|  |  |  |  | Incomplete | I | 0.0 |  |
|  |  |  | A letter grade I (incomplete) shall be awarded for courses that could not be completed in one semester, which will continue through to the next semester. |
|  |  | **6.2** | **A Semester Wise Grade Point Average (SGPA)** shall be computed for each semester. The SGPA will be calculated as follows: |
|  |  |  | $$SGPA=\frac{\sum\_{i=1}^{n}C\_{i}G\_{i}}{\sum\_{i=1}^{n}C\_{i}}$$ |
|  |  |  | where, n is the number of courses offered during the semester, Ci is the number of credits allotted to a i’th course and Gi is the i’th grade point corresponding to the grade awarded for that course. |
|  |  | **6.3** | **A Cumulative Grade Point Average (CGPA)** shall also be computed at the end of second and third semester in the following way: |
|  |  |  | $$CGPA=\frac{\sum\_{i=1}^{m}S\_{i}C\_{i}}{\sum\_{i=1}^{n}C\_{i}}$$ |
|  |  |  | where, m is the total number of semesters being considered, Si is the SGPA of a i’th semester, Ci is the total number of credits in i’th semester. |
|  |  | **6.4** | Both SGPA and CGPA will be rounded off to the second place of decimal for reporting. **For instance, SGPA=2.212 shall be rounded off as SGPA=2.22.** |
|  |  | **6.5** | **Earned Credit:** The courses in which a student has obtained minimum ‘D’ in ‘Theoretical courses’ and ‘C’ in ‘laboratory/field work/in-plant training and viva-voce’ will be counted as credits earned by the student. However any course in which a student has earned ‘F’ grade in theoretical and ‘F’ and ‘D’ grades in laboratory/field work/in-plant training and viva-voce will stay permanently on the grade sheet and transcripts. |
|  | **7.** | **Duration of Examination** |
|  |  | Duration of Theoretical examination of different courses shall be as follows: |
|  |  |  | Courses of 2 credits or less than 2 credits 2 Hours |
|  |  |  | Courses of more than 2 credits 3 Hours |
|  | **8.** | **Conduct of Examination and Rules for Promotion** |
|  |  | **8.1** | The results shall be finalized at the end of each semester conducted by the Examination Committee of the Department. |
|  |  | **8.2** | 1st and 2nd Semester results must be published by the Controller of Examination. The results shall be finalized at the end of the 3rd semester of the programme. |
|  |  | **8.3** | **Minimum passing grade:** The minimum passing grade in a **theoretical course** will be **D** and the minimum passing grade in a **laboratory/project/field work/in-plant training and viva-voce course** will be **C**. |
|  |  | **8.4** | **Promotion to higher semester:** A student who has a grade point average of 2.2 or higher, F grade in not more than 4 credit points and at least C grade in the laboratory/field work/in-plant training and viva-voce courses of the 1st and 2nd semester shall be promoted to the 2nd and 3rd semester, respectively. |
|  |  | **8.5** | There shall be **no improvement** in laboratory/field work/in-plant training/project and viva-voce courses. A student failing to secure a **minimum C grade** in any of these courses in any semester shall **fail the semester.** |
|  |  | **8.6** | **Grade Point Improvement:** |
|  |  |  | 8.6.1 | A promoted student who obtains less than B grade in theoretical courses in any semester, may appear in the upcoming regular examination of that semester to improve the grade points. |
|  |  |  | 8.6.2 | Grade obtained by a student in the courses in which he/she appeared for improvement will be recorded for final assessment according to clause 8.6.1 and the grade obtain by him/her in those courses at the regular final examination shall automatically cancelled. |
|  |  |  | 8.6.3 | Clause 8.6.2 is not valid for a candidate who cannot improve his/her course grade; in that case the previous grade shall remain valid. |
|  |  | **8.7** | **Course Exemption:** Students who fail to be promoted to the 2nd and 3rd semester shall be exempted from taking the theoretical and laboratory courses where they obtained grades **equal to or better than B**. These grades would be counted towards calculating SGPA in the retained semesters. |
|  |  | **8.8** | **Merit Position:** The SGPA obtained by a regular student in a **semester final examination** will be considered for determining the **merit position for the award of scholarships, stipends etc.** |
|  | **9.** | **Class Test** |
|  |  | **9.1** | **For theoretical** courses of **less than or equal to 2 credits,** there shall be **at least three** class tests and **at least four** class tests for **greater than 2 credits** in a semester. |
|  |  | **9.2** | The course must submit the detailed class test marks and their average in percentage to the Chairman of the Examination Committee in a sealed envelope. A copy will be also sent to the Controller of the Examination. If a course is conducted by more than one course teacher, class test marks will be processed by the Examination Committee. |
|  |  | **9.3** | Previous class test marks will remain valid for the reported/course improvement student if he/she is unable to appear at regular class test. |
|  | **10.** | **Publication of Results** |
|  |  | **10.1** | A student must successfully complete the courses of all the semesters within maximum **three and a half academic years** as outlined by the Committee of Courses with all its pre-requisites in order to be eligible for the award of M. Engg. degree. The student must **earn 40 credit points (i.e. no ‘F’ grade) and the CGPA** for the student must be **2.25 or higher**. |
|  |  | **10.2** | In the tabulation sheet, there should be one extra column for providing **CA** marks for each course. |
|  |  | **10.3** | The final merit position will be based on **CGPA.** |
|  |  | **10.4** | **Dean’s List:** As a recognition of excellent performance, the names of students obtaining a SGPA of 3.75 or above in two regular semesters in each academic year may be published in the Dean’s List in the faculty. Students who have received **an ‘F’ grade** in any course during any of the two regular semesters will not be considered for Dean’s List in that year. |
|  | **11.** | **Eligibility for Examination** |
|  |  | **11.1** | A candidate may not be admitted to any semester final examination unless he/she has |
|  |  |  | 11.1.1 | Submitted to the Registrar/Vice-Chancellor an application in the prescribed form for appearing at the examination. |
|  |  |  | 11.1.2 | Paid the prescribed examination fees, and outstanding of all University and Hall dues. |
|  |  |  | 11.1.3 | Fulfilled the conditions for attendance in class. |
|  |  |  | 11.1.4 | Not barred by any disciplinary rule. |
|  |  | **11.2** | On special circumstances the Vice-Chancellor may permit a student to appear at the examination. |
|  |  |  |  |

**Distribution of Marks (as per course types)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Theoretical Courses** | ContinuousAssessment (**CA**) | Class Participation and Attendance | 10% | 30% |
| Quizzes/Class Test/Assignment | 20% |
| Semester Final Examination | 70% |
| **Thesis** | **Two External Examiners (Average of the marks)**(Any teacher from the panel of examiners other than supervisor)(Based on quality of analysis, design, organization, writing style etc.)**Defence and Viva-voce of the thesis**(will be conducted by the respective examination committee) | 75%25% |
| **Basis for awarding marks for class participation and attendance** |
|  | **Attendance** | **Marks** |  |
|  | 90% and above | 100% |  |
|  | 85% to less than 90% | 90% |  |
|  | 80% to less than 85% | 80% |  |
|  | 75% to less than 80% | 70% |  |
|  | 70% to less than 75% | 60% |  |
|  | 65% to less than 70% | 50% |  |
|  | 60% to less than 65% | 40% |  |
|  |  less than 60% | 0 |  |

**Courses offered to the M. Sc. Engg. Students of the Department of Materials Science and Engineering**

**Distribution of Courses**

|  |  |
| --- | --- |
| **Course Type for M. Sc. Engg. (MSE)** | **Credits Distribution** |
| Theoretical | 26 |
| Thesis | 12 |
| Board Viva-voce | 2 |
| **Total Credits** | **40** |

**Credits Distribution (Semester-wise)**

|  |  |  |
| --- | --- | --- |
| **Semester** | **Nature of Course** | **Credits Distribution** |
| **1st Semester** | Theoretical | 14 |
| **Total** | **14** |
| **2nd Semester** | Theoretical | 12 |
| Board Viva-voce | 2 |
| **Total** | **14** |
| **3rd Semester** | Thesis | 8 |
| Thesis Viva-voce | 4 |
| **Total** | **12** |
| **(1stSemester+2ndSemester+3rdSemester) Total** | **40** |

**Course Code and Course Title for M. Sc. Engg. (MSE) 2022-2023**

**M. Sc. Engg. 1st Semester 2022**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.** | **Course Title** | **Units** | **Credits** | **Marks** |
| MSE M1111 | Advanced Engineering Materials | 0.75 | 3 | 75 |
| MSE M1121 | Nanotechnology | 0.75 | 3 | 75 |
| MSE M1131 | Engineering of Textile Materials | 0.75 | 3 | 75 |
| MSE M1141 | Thin Films | 0.75 | 3 | 75 |
| **OPTIONAL** | **One Optional Course From the Following** |  |  |  |
| MSE M1151 | Advanced Ceramics | 0.50 | 2 | 50 |
| MSE M1161 | Magnetic Materials | 0.50 | 2 | 50 |
| MSE M1171 | Biodegradable Polymers | 0.50 | 2 | 50 |
| MSE M1181 | Extractive Metallurgy | 0.50 | 2 | 50 |
|  | Polymer Composites  |  |  |  |
|  | Waste Materials Recycling |  |  |  |
|  | Materials for Renewable Energy |  |  |  |
|  | **Total** | **3.50** | **14** | **350** |

**M. Sc. Engg. 2nd Semester 2023**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.** | **Course Title** | **Units** | **Credits** | **Marks** |
| MSE M2111 | Opto-electronic Materials and Devices | 0.75 | 3 | 75 |
| MSE M2121 |  Nuclear Engineering | 0.75 | 3 | 75 |
| MSE M2131 | Functional Polymers | 0.75 | 3 | 75 |
| MSE M2141 | Biomaterials | 0.75 | 3 | 75 |
| MSE M2110 | Board Viva-voce | 0.50 | 2 | 50 |
|  | **Total** | **3.50** | **14** | **350** |

**M. Sc. Engg. 3rd Semester 2023**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.** | **Course Title** | **Units** | **Credits** | **Marks** |
| MSE M3112 | Thesis | 2 | 8 | 200 |
| MSE M3110 | Thesis Viva-voce | 1 | 4 | 100 |
|  | **Total** | **3** | **12** | **300** |

**Course Outline**

**1st Semester Examination 2022**

|  |  |
| --- | --- |
| **Course Code:** MSE M1111 | **Course Title:** Advanced Engineering Materials |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Md. Shahnawaz Parvez Prof. Dr. M. Saidul Islam |  |
| **Course Description:** Materials are an inherent part of human life. Different types of materials are required in different fields of science and engineering. However, engineering materials play a crucial role in the various types of machinery and equipment used in industries communications as well. The challenges of the current world are constantly fuelling the discovery and development of new kinds of materials with desired properties and the right cost to meet the constant demand. This course will provide advanced knowledge about the properties, internal structure, and the development of high-performance alloys like aluminium, titanium as well as superalloys. These alloys are extensively used in aircraft, turbine engine, and submarine. |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help to enrich the knowledge of the students about the properties, internal structure, and processing of high-performance alloys.
2. They will be able to develop high-performance alloys by modifying the existing alloys.
3. The specific applications in civil and military applications like aircraft, jet engines, and submarines.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Achieve advanced knowledge about high performance alloys.
2. Fabrication and modification existing alloys.
3. Development of new compositions with enhances properties.
4. Design and selection of appropriate material.
5. Apply the in specific applications like aircrafts, jet engine, submarine.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1****CLO-2****CLO-3** | 1. **Aluminium Alloys:** Designation of Aluminium Alloys, Application of Aluminium Alloys, Constitutions, Properties and Processing, Nickel Aluminides, Aluminium-Lithium Alloys, Superplastic Aluminium Alloys, Rapid Solidification Processing of Al Alloys, Mechanical Alloys of Aluminium, High Strength Aluminium Alloys.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-1****CLO-2****CLO-3** | 1. **Titanium Alloys:** Basic Alloying and Heat Treatment Features, Processing of Titanium Alloys, Titanium Aluminides, Formable Titanium Alloys for High Speed Vehicles, Titanium-based Alloys for Fan Blades, Superplastic Forming and Diffusion Bonding, Development and Processing of Titanium Alloys for Compressor Blade and Disc Operations.
 |
| **CLO-1****CLO-2****CLO-3** | 1. **Super and Shape Memory Alloys:** Concept of Superalloys, Importance, Basic Alloying Features, Strengthening Mechanisms in Superalloys, Alloy Design and Processing to Improve Performance, Nickel-based Super Alloy, Dispersion-hardened Super Alloys.Materials Showing Shape Memory, Mechanism and Characteristics of Shape Memory Effect (SME).
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|  | **Section-B** |
| **CLO-4****CLO-5** | 1. **Aero-space Materials:** Introduction, Design Criteria for Aero-Space Structures; Materials for Aero-Space structures: Materials Selection Criteria, Metals and Alloys, Ceramics and Composites for Aero-Space Structures.
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| **CLO-4****CLO-5** | 1. **Jet Engine Materials:** Jet Engine and its Construction Materials, Thermal and Radiation Protective Materials for jet Engine.
 |
| **CLO-4****CLO-5** | 1. **Submarine Materials:** Introduction, General Requirements for Submarine; Principles for Design and Construction of Submarine; Selection of Materials for Submarine, Pressure Hull and its Construction Materials, Materials for Sonar Equipment’s; Radiation Protective Materials for Nuclear Submarine.
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| **Recommended Books:** |
| 1. Titanium and Titanium Alloys Christoph Leyens and Manfred Peters
2. Aluminum Alloy Castings J. Gilbert Kaufman and Elwin L. Rooy

Properties, Processes, and Applications1. Superalloys Blaine Geddes, Hugo Leon and Xiao Huang

Alloying and Performance1. Shape Memory Alloys Dimitris C. Lagoudas
2. Modern Physical Metallurgy R.E. Smallman and R.J. Bishop
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| **Course Code:** MSE M1121 | **Course Title:** Nanotechnology |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof.Dr. Md. Anwarul Kabir Bhuiya Prof. Dr. Md. Asadul Hoque |  |
| **Course Description:** Early in the history of science it became evident that to a large extent, material properties are determined at the molecular level. As technology progressed, allowing the observation and detailed analysis of increasingly smaller objects, novel material properties that are unique to the nanometre length scale also emerged. Combining the promise provided by the unique behaviour at small scales with the obvious utility of miniaturization affords the main drive for this field. This course will discuss the preparation and fabrication techniques of different nanostructures, their properties and application in electronics, magnetic and optoelectronics devices. Different theoretical and practical aspects of nanotechnology will be discussed for developing the clear concept and understanding on structure-property relationship. |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will demonstrate the theoretical aspect of micro and nano-phase separation mechanism. The chemistry behind the phase separation phenomena and intermolecular interaction and bonding properties will be discussed.
2. The student will acquire knowledge about technological aspect of nanotechnology, the selection of appropriate materials, control preparation of nano-structures, and characterizations.
3. At the end of the course, the students will be able to design, synthesize, and fabrication of new nanostructures and tuning the structure-properties relationship and explore their new applications.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Understand the theoretical aspect and mechanism of nano-phase separation and self-organizing mechanism.
2. Driving forces and intermolecular interaction behind the nano-phase separation
3. Formation of monolayer, multilayer, nano rod, nanopilar, nano hole and tuning of aspect ratios of the nanostructures.
4. Demonstrative constructions and application of nanostructures for electronic, optoelectronic, NEMS and MEMS
5. Design and synthesis of nanostructures for specific applications
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-2** | 1. **Preparation and Processing of Nanostructured Materials:** Chemical Synthesis methods-Sol-Gel and Spray Pyrolysis method; Thermal Spray Processing, Electrochemical and Polymer Templeting Method; Preparation of Nanoparticles-dots-pillars and Monolayer.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-2****CLO-4** | 1. **Fullerenes and Carbon Nanotube:** Families, Reactivity, Potential Applications of Fullerenes, Molecular and Supramolecular Structures of CNT, Intrinsic Properties of SWCNT, Synthesis and Processing, Characterization, Modification and Application of CNT.
 |
| **CLO-4** | 1. **Quantum Dots And Magnetoresistive Nanomaterial Devices:** Quantum Mechanical behaviours, 3D Quantum Dots, Colloidal And Epitaxial Growth, formation of Quantum Dots; Magneto resistivity, magnetic storage and memory devices.
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| **CLO-4** | 1. **Magnetoresistive Nanomaterials and Devices:** Basic Concepts of Magnetoresistance, Read-Write Heads and MRAM, Fundamentals of Magnetic Storage, Fabrication Engineering and Scaling.
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|  | **Section-B** |
| CLO-1CLO-2 CLO-3 | 1. **Self-Assembly and Self-Organisation:** Advantages of Self- Assembly, Intermolecular Interaction, Self-Assembled Monolayers, Electrostatic Self-Assembly, Self-Organization in Block Copolymers.
 |
| CLO-3CLO-4CLO-5 | 1. **Organic Optoelectronic Nanostructures:** Organic and Polymeric Light-Emitting Diodes, Photovoltaic Polymers, Self- Assembled Organic Nonlinear Optical Materials.
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| CLO-1CLO-4 CLO-5 | 1. **Photonic Crystals:** Photonic Band Structures and Band Gaps, Photonic Crystals by Microfabrication and Self- Assembly.
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| CLO-1CLO-4 CLO-5 | 1. **Nanobiotechnology:** Cell Inspirations and Copolymers, Biomolecular Motors, Operation and Function of Motor Molecules, Molecular Motors in Technological Applications.
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| **Recommended Books:** |
| 1. Introduction to Nanoscale Science M. D. Ventra, S. Evoy

and Technology and J. R. Heflin (ed)1. Nanostructured Materials-Processing, C. C. Koch (ed)

Properties and Potential Applications1. Handbook of Nanoscience and Engineering W. A. Goddard, D. W. Brenner

 S. E. Lyshevski and G. J. Iafrate |
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| **Course Code:**MSE M1131 | **Course Title:** Engineering of Textile Materials |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof.Dr. G. M. Shafiur Rahman Prof.Dr. Jahanara Nasrin |  |
| **Course Description:** The textile and clothing is the largest manufacturing activities in the country.  There is almost 45% employment of the total industrial employment in the country.  During the last half century natural fibers are greatly substituted by synthetic fibres. In this respect, textile science has drawn incredible attention of the academician and researchers.  Considering the diversified use of textile, the course “**Engineering of Textile Materials**” has been introduced to develop high caliber graduate for serving the next generation textile innovation. |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. To earn adequate knowledge with different Textile materials.
2. To enable students to develop articles using dyeing and printing techniques and also to understand the importance of finishes.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Students will develop understanding regarding textile materials like fibers, fabrics and their use in Bangladeshi textile sector.
2. Students will develop understanding about fiber synthesis, composition, and their creative use.
3. With the acquired knowledge students will be able to gain knowledge regarding structure, properties, and processing of different kinds of fiber and fabrics.
4. To make informed choices while selecting fabrics for finishing creating garments or other related products.
5. To learn how to test the textile materials.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1** | 1. **Introduction to Textiles:** Textile Materials, Sources, and Classification, Prospects of Textile Industry in Bangladesh, Scopes of Textile Industry, Importance of Textile industry, Scenario of Textile Industry and Drawbacks of Textile Industry in Bangladesh.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-2****CLO-3** | 1. **Synthesis and Shaping of Fibres:** DMT From P-Xylene, TPA – Amoco Process, MEG – Oxidation, Acetoxylation Process,  Caprolactum From Phenol, Toluene, Cyclohexane, Aniline, Acrylonitrile From Acetylene And Propylene, Raw Material For Rayons, Fibre- PET Through TPA And DMT Route, Nylon 66 And Nylon 6-, Acrylic-, Polypropylene-, Elastomeric-, Polyvinyl And Aramid Fibres, Blending, Drying, Melting, Spinning And Drawing Of Fibres.
 |
| **CLO-2****CLO-3****CLO-4** | 1. **Structure of Fibres:** Physical and Chemical Morphology of Man-Made Fibres, Basics of Texturing– Texturability of Various Fibres– Process Parameters- Temperature, Twist Tension-Suitability for FT (false-twist) Texturing-Draw Texturing-Simultaneous and Sequential Draw Txturing-Twisting Devices Testing of Textured Yarns..
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|  | **Section-B** |
| **CLO-2****CLO-3****CLO-4** | 1. **Chemical Modification, Dyeing and Printing of Textiles:** Introduction To Bleaching, Dyeing, Dyeing Engineering, General Theory of Dyeing, Dyeing Mechanics, Dyeing Machenary,Dyeing With Acid, Basic, Direct, Mordant, Disperse And Reactive Dyes. General Theory and Techniques of Printing. Digital Printing of fabrics.
 |
| **CLO-3****CLO-4** | 1. **Textile Finishing and fabric Care**: Surface Finishing, Recent Development in Finishing Technology. Classification of Finishing, Mechanical, Chemical and Thermal Finishing, Types of finishing Chemicals, baric care
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| **CLO-3****CLO-4****CLO-5** | 1. **Testing of Fibers and Fabrics:** Testing of dyes and dyeing, Evaluation of the color yields of dyes, Dye fastness, Identification of dyes on the fiber, Spectrophotometric analysis of dye solutions**.** Basic Techniques for the Measurement of Fiber Properties, X-ray FT-IR and SEM for fiber testing, Tensile Strength and Water Repellence. Moisture Absorptive of Fibers;
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| **Recommended Books:** |
| 1. Physical methods of investigation of Textiles R. Meredith and J.W.S. Hearle
2. Physical Properties of Textile Fibers W.E. Mortonn and J.W.S. Hearle
3. Hand Book of Textile Fibers M. Milton Harris
4. Textile Science an explanation of fibre Properties E.P.G. Gohl and L.D. Vilensky
5. Basic Principles of Textile coloration Arthur D Broadbent
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| **Course Code:**MSE M1141 | **Course Title:** Thin Films |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof. Dr. Md. Abdus Sattar Prof. Dr. Md. Abdul Halim |  |
| **Course Description:** Thin film science and technology play a crucial role in the high-tech industries. The major exploitation of the thin films has been in microelectronics. There are numerous and growing applications in communications, optical electronics, coatings of all kinds, and in energy generation and conservation strategies. This course covers the following topics: different fabrication and characterization techniques of thin films, electrical, optical and mechanical properties of the thin films and some modern applications of thin films |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help the students to critically choose, fabricate and analyse different types of thin films materials that can be applied in communications, energy generation and conservation strategies.
2. They can select and modify thin film materials according to electronic and optoelectronic purpose.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Understand the scientific meaning of thin films and thick films materials.
2. Thin films materials for specific need of modern technology.
3. Synthesis, fabrication technique of thin films materials.
4. Characterization of different thin films materials.
5. Study of the different properties of thin films materials.
6. Modern application of thin films.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1****CLO-3** | 1. **Introduction to Thin Films:** Fundamental of Thin Films, Theories, Atomistic Nucleation Processes, Cluster Coalescence and Depletions, Experimental Studies of Nucleation and Growth, Grain Structures, Amorphous Thin Films.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-2****CLO-3** | 1. **Modifications of Surfaces and Films:** Laser and Their Interaction with Surfaces, Laser Modification Effects and Applications, Ion-Implantation Effects in Solids, Ion-Beam Modification Phenomena and Applications.
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| **CLO-3**  | 1. **Fabrication of Thin Films:**Fabrication of Thin Films by Physical Vapour Deposition, Chemical Vapour Deposition and Electro-deposition, Modern Techniques for Film Formation.
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| **CLO- 4** | 1. **Characterization of Thin Films:**Film Thickness, Structural Characterization and Chemical Characterization.
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|  | **Section-B** |
| **CLO-1****CLO-3** | 1. **Interdiffusion and Reactions in Thin Films:** Electro migration in Thin Films, Metal-Semiconductor reactions, Silicides and Diffusion Barriers, Diffusion During Film Growth.
 |
| **CLO-5** | 1. **Mechanical Properties:** Stress in Thin Films, Relaxation Effect in Stressed Films, Adhesion, Hardness Test, Tribology
 |
| **CLO-5** | 1. **Electrical and Optical Properties:** Conduction in Metal Films, Electrical Transport in Insulation Films, Semiconductor Contacts, Properties of Optical Film Materials, Thin Film Optics, Multilayer Optical Film Applications.
 |
| **CLO-2****CLO-6** | 1. **Modern Thin Film Materials and** A**pplications:** Films Patterning Techniques, Diamond Films, High-Tc Superconductor Films, Films for Magnetic and Optical Recording, Integrated Optics, Super lattices, Band Gap Engineering and Quantum Devices.
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| **Recommended Books:** |
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| 1. | The Materials Science of Thin Films | M. Ohring |
| 2. | Thin Film Materials Engineering | KiyotakaWasa, Makoto Haber and Hideaki Adachi |
| 3. | Materials Processing and Manufacturing Sciecnce | Rajiv Asthana, Ashok Kumar and Narendra Dahotre |
| 4. | Thin Film Phenomena | K. L. Chopra |
| 5. | Hand Book of Thin Film Engineering | Maissed and Glang |
| 6. | Thin Film Engineering | C. G. Gavanqirst and G. A. Niklassons |

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| **Course Code:** MSE M1151 | **Course Title:** Advanced Ceramics |
| **Course Credit:** 2 |  |  |
| **Course Teacher:** Prof.Dr. M. Saidul Islam Prof.Dr. Mirza Humaun Kabir Rubel |  |
| **Course Description:** The principles of functional ceramics, their structure, and the materials design strategy for the creation of advanced ceramics with fascinating a variety of physical-chemical properties are taught in this course. The first section of the course module covers the fundamental science that underlies the characteristics and uses for comprehending the field and technology of functional ceramics. The students will gain a thorough understanding of the mechanical, thermal, electrical, optical, optoelectronic, magnetic, multiferroic, magneto-electric, and optoelectronic properties of advanced ceramic materials in the following module. Dielectrics, ferroelectric/piezoelectric devices, ceramic semiconductors, superconductors, ceramic armor, cutting and grinding tools, fiber communications, lasers, optical displays, thermal barrier coatings, nuclear fuel pellets, high-temperature fiber insulation, battery technology, and biotech applications are examples of such applications. Additionally, the research concept will be addressed in order to recognize and address the technical issues before moving forward with additional research activities. Numerous complementary intrinsic and extrinsic methodologies are used to comprehend and produce functional advanced ceramics in order to achieve these goals.  |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will assist students to learn more about the characteristics, structure, manufacture, and properties of advanced ceramics.
2. They will be able to carry out research and develop functional ceramics by modifying the methods and compositions of existing functional ceramics.
3. They will learn about the numerous promising applications including spintronic, memory devices, capacitors, lasers, optical fibers, MRI, and biotech fields.
 |
| **Course Learning Outcome (CLO):**After successfully completing this course the students should be able to: |
| 1. Acquire fundamental knowledge of advanced ceramic materials.
2. Fabrication, modification, and characterizations of functional ceramics.
3. Development of new compositions and structures with noble properties.
4. The specific applications in spintronic, dielectrics, optoelectronic, magnetic, and magneto-electric areas.
5. Challenges, problems, opportunities, and future aspects of advanced ceramics.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1****CLO-2****CLO-3** | 1. **Fundamental of Ferroelectrics:** Ferroelectrics, Classification of Ferroelectrics, Remnant Polarization, Cohesive Field, Hysteresis Behaviour, Curie Temperature and Phase Transitions, Landau’s Theory of Phase Transitions, First Order Phase Transitions, Second Order Phase Transitions, Order
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 50Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-1****CLO-2****CLO-3** | 1. **Piezoelectric Ceramics:** Introduction, Piezoelectric Effect in Ceramics, Measurement Techniques, Perovskite Structure Piezoelectric, Non-Perovskite Oxide Piezoelectric, Manufacture of Piezoelectric Ceramics, Applications of Piezoelectric Ceramics, Relaxor Ferroelectrics**.**
 |
| **CLO-1****CLO-2****CLO-3** | 1. **Lead free Ceramics:** Barium Titanate, Layered-Structured Ferroelectric, Tungstin-bronze structured ferroelectrics, and Other Titanate Based ferroelectric, Anti-ferroelectrics, Processing of Thick &Thin Film Capacitors, and Integrated Capacitors.
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|  | **Section-B** |
| **CLO-4****CLO-5** | 1. **Optoelectroceramics:** Introduction, Basic Properties of Optoelectroceramics, Methods for Measuring Optical Properties, Processes for Preparation of Optoelectroceramics, CRT and TV Picture Tubes, Telecommunication and Related uses, Information Display, Laser, Fibber Optics, Electromagnetic Windows.
 |
| **CLO-4****CLO-5** | 1. **Magnetic Ceramics:** Introduction, Classes of Magnetic Ceramic, Crystal Structures of Magnetic Ceramics, Preparation of Magnetic Ceramics, Properties of Magnetic Ceramics, Magnetic Ceramic, Ferrite and other Materials, Application of Magnetic Ceramics.
 |
| **CLO-4****CLO-5** | 1. **Electro-Magnetic and Superconducting Ceramics:** Introduction, Basic Properties of Superconducting State, Theory of Superconductor, Structures of Superconducting Ceramics, Fabrication Methodology, High-Tc Superconducting Materials, Phase Diagram of High-Tc Superconducting Ceramics, Defect Chemistry of Superconducting Ceramics Applications
 |
| **CLO-4****CLO-5** | 1. **Bio-ceramics:** Introduction, Alumina- Source Composition and Structure, Mechanical Properties, Fatigue Properties and Service Life, Applications, Zirconia- Source and Manufacturing, Long-Term Stability and Implant Design, Applications, Bioactive Glasses.
 |
| **Recommended Books:** |
| 1. Principles and Applications of Ferroelectrics Y. Xu, M. E. Lines and A. M. Glass

and Related Materials1. Principles of Electronic Ceramics Larry L. Hench, Jon K. West
2. Piezoelectric Materials and Devices M.S. Vijaya
3. Handbook of Advanced Ceramics: Materials, Shigeyuki Somiya

Applications, Processing, and Properties1. Introduction to Superconductivity Michael Tinkham
2. Room-temperature superconductivity Andrei Mourachkine
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| **Course Code:** MSE M1161 | **Course Title:** Magnetic Materials |
| **Course Credit:** 2 |  |  |
| **Course Teacher:** Prof.Dr. Md. Anwarul Kabir Bhuiya Prof. Dr. Md. Mijanur Rahaman |  |
| **Course Description:** Magneticmaterials and magnetism based various modern devices such as electrical power generators and transformer, television, telephones, computers, and components of sound and video reproduction systems have been extensive utilized in our daily lives. Therefore, the study of underlying principles and mechanism that explain magnetic phenomena in magnetic materials are indispensable. This course is designed to comprehend the students about the mechanism of magnetism including magnetic domain structure, domain wall motion, domain rotation, and how they contribute to the magnetization process. This course is also dealing with classification of magnetic materials and their applications to different modern devices.  |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help the students to design and analyse various types of magnetic materials that can be applied in different types of modern technologies.
2. They can select and modify the properties of materials according to specific devices applications.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Chose magnetic materials and explain why some materials are magnetically soft and others are magnetically hard.
2. Acquire knowledge about domain structure and the hysteresis loop.
3. Understand the factors which affect the shape of the hysteresis loop.
4. Select and design magnetic materials for commercial purpose.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1** | 1. **Magnetic materials:** Introduction, Iron group metals and alloys, Rare-earth metals and inter metallic compounds, Interstitial compounds, Oxides with ferromagnetic interactions, Oxides with antiferromagnetic interactions, Miscellaneous materials.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-1****CLO-4** | 1. **Soft magnets and its Applications:** Introduction, Eddy Currents, Losses in Electrical Machines, Soft magnetic materials, Electrical Steel, Special Alloys, Soft Ferrites, Static applications, Low-frequency applications, High-frequency applications.
 |
| **CLO-1****CLO-4** | 1. **Hard Magnetic Materials and Its Application:** Introduction, Permanent magnet materials, Operation of Permanent Magnets, Magnet Steels, Alnico, Barium and Strontium Ferrite, Rare Earth Magnets, Exchange-Spring Magnets, Nitride Magnets, Ductile Permanent Magnets, Artificial Single Domain Particle Magnets (Lodex), Bonded Magnets, Magnet Stability, Applications.
 |
| **CLO-4** | 1. **Magnetic Materials for Recording and Computers:** Introduction, Magnetic Recording, Principles of Magnetic Recording, Magnetic Digital Recording, Perpendicular Recording, Magneto-Optic Recording, Magnetic Memory.
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|  | **Section-B** |
| **CLO-3** | 1. **Magnetic Anisotropy:** Introduction, anisotropy in cubic crystal, anisotropy in hexagonal crystal, physical origin of crystal anisotropy, anisotropy measurement, anisotropy constant, polycrystalline materials, anisotropy in antiferromagnetics, shape anisotropy, mixed anisotropies, Exchange Anisotropy.
 |
| **CLO-2****CLO-3** | 1. **Magnetostatics:** The magnetic dipole moment, Magnetic fields, Maxwell’s equations, Magnetic field calculations, Magnetostatic energy and forces, Effect of Stress on Magnetic Properties, Applications of Magnetostriction.
 |
| **CLO-2**  | 1. **Domains and the Magnetization Process:** Introduction, Domain Wall Structure, Domain Wall Observation, Magnetostatic Energy and Domain Structure, Single-Domain Particles, Micro-magnetics Domain Wall Motion, Hindrances to Wall Motion (Inclusions) Residual Stress, Hindrances to Wall Motion (Microstress), Hindrances to Wall Motion (General), Magnetization by Rotation, Magnetization in Low Fields Magnetization in High Fields, Shapes of Hysteresis Loops, Effect of Plastic Deformation (Cold Work).
 |
| **CLO-3****CLO-4** | 1. **Magnetic Fine Particles and Thin Films:** Introduction, Single-Domain vs Multi-Domain Behaviour, Coercivity of Fine Particles, Magnetization Reversal by Spin Rotation, Magnetization Reversal by Wall Motion, Superparamagnetism in Fine Particles, Superparamagnetism in Alloys, Preparation and Structure of Thin Films, Induced Anisotropy in Films, Domain Walls in Films, Domains in Films.
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| **Recommended Books:** |
| 1. Introduction to Magnetic Materials B. D. Cullity, C. D. Graham
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| **Course Code:** MSE M1171 | **Course Title:** Biodegradable Polymers |
| **Course Credit:** 2 |  |  |
| **Course Teacher:** Announce to be latter |  |
| **Course Description:**  |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
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| **Course Learning Outcome (CLO):** |
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
|  | 1. **Development of Biodegradable Polymers:** Concept of biodegradable polymers, degradable polymers for ecological balance, biodegradable polymers for agriculture and medical uses, synthesis of biodegradable polymers. Chemical reactions of polymers modification, hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution, cross-linking. Degradable polymer synthesis techniques, purification of synthesized polymers, biodegradable polymer composites.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 50Attendance:10%Tutorial/Quiz:20%Exam: 70% |
|  | 1. **Mechanism of Enzymatic Degradation of Polymers:** Modes of biological degradation; enzymatic degradation in bio polymers (polysaccharides, proteins, malice acids), factors affecting the activity of enzymes, enzyme mechanism, microbial degradation of synthetic polymers, solubilization by cross link cleavage, solbilization by hydrolysis, ionization or protonizatation of pendent group, solubilization of backbone cleavage, homogeneous and heterogeneous hydrolytic erosion.
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|  | 1. **Mechanism of Physical Degradation of Polymers:** Thermal degradation: Introduction, methods for evaluation of heat resistance (dta, dsc, tga, tma), mechanistic aspects, heat resistance polymers, ablation, stabilization, thermal degradation and recycling, heat effect in biopolymers. Photo degradation: Introduction, mechanistic aspects; excited states, free radicals and ionic species, energy transfer and energy migration, degradation in the absence of oxygen, norrish types i and ii reactions, photo-oxidation, auto-oxidative process, sensitized degradation.
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|  | **Section-B** |
|  | 1. **Test Methods and Standards for Biodegradability:** Definingbiodegradability, criteria used in the evaluation of biodegradable polymers, tiered systems for evaluating biodegradability, choice of environment, choosing the most appropriate methodology, description of current test methods, screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, other methods for assessing biodegradability, petri dish screen, environmental chamber method, soil burial tests, bacterial test, hydrolytic test.
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|  | 1. **Biomedical Applications of Polymers:** Criteria for the selection of biomedical polymers. Synthetic polymers such as PMMA, silicon rubber, polyethylene, natural rubber, hydrogels, permanent implants for function- orthopaedics, cardio vascular, respiratory patches and tubes, other applications of engineered material in clinical practices, silicone implants. polymer membranes, polymer skin, polymeric blood.
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|  | 1. **Mechanism of Controlled Release Formulation:** Diffusion of Bioactive agents through polymers. Classification of polymer membranes; macro, micro and non-porous membranes, diffusion controlled release systems, reservoir system, matrix systems, systems with of dissolved drugs and systems with dispersed drugs , polymers for controlled diffusion controlled systems.
 |
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| **Recommended Books:** |
| 1. Polymer Degradation – Principles W.Schnabel

and Practical Applications1. Degradative Polymers Recycling Ann CAlbertsson, Samuel J. Huang

and Plastic Waste Management1. Chemistry & Engineering of G.J.L Griffin Blackie (ed.)

biodegradable polymers1. Biodegradable plastics & Polymers Yoshiharu Doi , Kazuhiko Fukuda
2. Handbook of Biodegradable polymers Abraham J. Donb and others (ed.)
3. Bio-Material David Byrom (Ed)
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| **Course Code:**MSE M1181  | **Course Title:** Extractive Metallurgy |
| **Course Credit:** 2 |  |  |
| **Course Teacher:** Dr.Mst. Jesmin SultanaMd. Asadul Islam |  |
| **Course Description:** Metallurgy is a domain of materials science and engineering that studies the physical and chemical behavior of metallicelements, their inter-metallic compounds, and alloys. Extractive metallurgy is a branch of metallurgy where in process and methods of extraction of metals from their natural mineral deposits are studied. The purpose of this course is to cover the types of ore, washing, concentration, separation, chemical processes and extraction of pure metal and their alloying to suit various applications, sometimes for direct use as a finished product, but more often in a form that requires further working to achieve the given properties to suit the applications. |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help the students to provide an understanding of the main chemical and technological principles used in the production of metals from their raw materials.
2. Exercises provide training in practical applications of the principles used in the production of metals.
3. It will help to discuss the properties of metals based on their electronic structure and their position within the Periodic Table.
4. It discusses mineral occurrences, sources of minerals and prospecting and mining of ores.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Access, evaluate and generate minerals and metallurgical information from multiple sources.
2. Communicate in ways appropriate to the discipline of mineral processing and extractive metallurgy.
3. Apply mineral and metallurgical scientific principles to the metallurgical process operation in the Metallurgical Plant.
4. Describe mineral processing operations and communicate professionally with mining industry.
5. Use and apply technologies, recognizing their advantages and limitations, when applied to minerals and metallurgical information.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1****CLO-2****CLO-4** | 1. **Concepts in Iron Making:** Blast furnace reaction and process dynamics; models for the blast furnace; agglomeration, sintering and pelletization-mechanims; blast furnace aerodynamics; irregularities.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 50Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-3****CLO-4** | 1. **Solvent Extraction:** Introduction, Extractants, Theory: Mechanism, Extraction isotherms; Organic phase: Polymerization of extractant, Effect of extractant concentration, Extraction by mixed solvents; Aqueous phase: Effect of metal ion concentration, Effect of foreign ions, Effect of pH, Effect of ion hydration, Extraction of water. Engineering aspects: Percent extraction,counter current extraction, economic aspects, Applications :recovery, separation.
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| **CLO-3****CLO-4****CLO-5** | 1. **Ion Exchange:** Introduction, General principles, Ion exchange materials: Inorganic exchangers, Organic exchangers, membranes, electron exchangers. Properties: Effect of complexing agents in the aqueous phase. Properties in non-aqueous media: Pure solvent, mixed solvent. Applications: recovery from each solution, metal separations.
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|  | **Section-B** |
| **CLO-1****CLO-2** | 1. **Electro-winning:** General principles and applications of electro-winning, electro-winning in aqueous media, electro-winning in molten salts, electro-winning of Cu, Ni, Co, Zn, Ca, Cr, Mn and Ga from aqueous media, electro-winning of Al, Mg, Ti, Li, Be and B from molten salts.
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| **CLO-3****CLO-4****CLO-5** | 1. **Electro-refining:** History, basic principles, anode, electrolytes, cathodes, applications of electro-refining, electro-refining of Cu, Ni, Co, Pb, Si, Au, Ag, Al, Fe, Sn, Ti, Sb, treatment of anode mud.
 |
| **CLO-4****CLO-5** | 1. **Electroforming:** Introduction, general principles ,advantages, electroforming solutions and deposit properties, anode materials, equipment for electroforming, management of electroform properties, preparation of materials, applications of electroforming, prospect of electroforming.
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| **Recommended Books:** |  |  |
| 1. Beyond the blast furnace A. Chatterjje
2. Iron making and steel making: Theory and practice A. Ghosh and A.Chatterjje
3. Principles of Extractive Metallurgy FathiHabashi
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**2nd Semester Examination 2023**

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| **Course Code:** MSE M2111 | **Course Title:** Opto-electronic Materials and Devices |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof.Dr. Md. Mijanur Rahaman Prof. Dr Md Abdul Halim |  |
| **Course Description:** This course is designed in order to study interaction of light (photon) with semiconducting material. Four groups of photonic devices are considered: light-emitting diode (LED), light amplification by stimulated emission of radiation (laser), photo-detector and solar cells. Among them LED and laser convert electrical energy to optical energy while photo-detector and solar cell convert optical energy to electrical energy. |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help the students to understand the interaction between light and materials.
2. They can select the appropriate materials to be used for solar cells, photodetectors, LED and LASER.
 |
| **Course Learning Outcome (CLO):**After studying this course students should be able to do the following:  |
| 1. Understand the interaction between light and semiconducting materials.
2. Selection and engineering of semiconducting materials to be used in optoelectronic device.
3. Understand the principle and applications of diode for LED and Laser.
4. Construction of solar cells by choosing appropriate materials layer.
5. Recommendation for high speed photodetector by comparing different types of detectors.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1** | 1. **Optical processes in Materials:** Absorption and Recombination of Materials, Band to Band Absorption, Donor-acceptor and Impurity Band Absorption, Long Wavelength Absorption. The Kramer’s Kronig Relation, Radiative and Non-Radiative Recombination, Band to Band Recombination, Near Band Gap Radiative Transitions, Deep Level Transition, Photoluminescence and measurement of Absorption and Luminescence Spectra.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-2**  | 1. **Photonic Materials and Processing:** Introduction, III-V Materials, Binary Compound, Ternary Alloys, Lattice Mismatch, Lattice Matched Ternary Alloy Structure, Compositional Grading, Heteroepitaxial Ternary Alloy Structure, Quaternary Alloys and Growth of Photonic Materials.
 |
| **CLO-3**  | 1. **Light Emitting Diodes:** Introduction, Electroluminescence Process, Choice of LED Materials, Efficiency of LED, Loss of LED, Light Output from LED, Heterojunction of LED, Guided Wave LED, Spectral Response of LED, Frequency Response and Modulation Band Width of LED, Man fracture Process and Application of LED, Defect and Reliability of LED.
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|  | **Section-B** |
| **CLO- 3** | **4. Lasers:** Stimulated Emission and Population Inversion, Optical Cavity, Junction Laser Operating Principle, Threshold Current, Heterojunction Lasers, Quantum Well Laser, Rare Earth Doped Laser, laser Device Fabrication, Tunnelling Based Laser. |
| **CLO-4****CLO-5** | **5. Photo Detectors and Solar Cells:** Photoconductor, Photodiodes, PIN Photodiode, Quantum Efficiency and Frequency Response, Heterojunction Photodiode, Avalanche Photodiode, Basic Principle of Solar Cells, Spectral Response, Heterojunction and Cascaded Solar Cells, Schottky Barrier Cells, Solar Cell Materials, Solar Cell Design and Cell Performance on External Factors. |
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| **Recommended Books:** |
| 1. Semiconductor Optoelectronic Devices P. Bhattacharya
2. Physics of Semiconductor Devices S. M. Sze
3. Crystal Growth P. S. Raghavan
4. Process and Methods Optical Materials S. Musileant
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| **Course Code:** MSE M2121 | **Course Title:** Nuclear Materials and Engineering |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof. Dr.Md. Anwarul Kabir Bhuiya Prof. Dr. Mirza Humaun Kabir |  |
| **Course Description:** This course describes the fundamental topics on understanding the behavior of materials in nuclear reactor and systems. Specially in this course, we will discuss about the basic nuclear materials to correlate fuel effects as well as radiation damage on structural design. The offered course comprises of readings, lectures, problem, research schemes and class discussions with worked examples between faculties and students. An overview of fundamental of nuclear phenomena, advanced nuclear materials, reactor design and engineering will be addressed initially. Afterwards, knowledge on phase diagram and crystal structure of materials such as metals, ceramics and complex alloys will be learnt for their advanced and possible applications in nuclear fields.  |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| The primal goals of the designed course are as follows:1. It will provide strong and fundamental background about the nuclear materials.
2. The established structure property relationship of nuclear materials will be helpful to understand the design of nuclear reactor and engineering.
3. This course will develop advanced ideas on reactor shielding, reactor parameters, waste disposal, and radiation protection and reactor safeguards.
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| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Gain knowledge on basic nuclear reactions and phenomena.
2. The applications of nuclear materials in power and research reactors.
3. How the common components of nuclear reactors work in the nuclear system.
4. How to control, maintenance and radiation protection during operating phase.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** |  |  |
| **CLO-1****CLO-3** | 1. **Introduction to Nuclear Reactor Engineering:** Introduction, Nuclear Energy and Nuclear Forces, Nuclear Fission, Nuclear Fission Reactors, Homogenous and Heterogeneous Reactor Systems. Components of Nuclear Reactors; Non-Nuclear Components of Nuclear Power Plants; Power Reactors and Nuclear Steam Supply Systems; PWR, Organic-Cooled Reactors; Gas-Cooled Thermal Reactors; Heavy-Water Reactor; Breeder Reactors: LMFBR; MSBR.
 | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-1****CLO-2** | 1. **Nuclear Reactions and Radiations:** Radioactivity, Interactions of Alpha and Beta Particles with Matter, Interactions of Gamma Rays with Matter, Interaction of Neutrons with Matter, Cross Sections for Neutrons Reactions, Variations of Cross Sections with Neutrons Energy, the Fission Process.
 |
| **CLO-2** | 1. **Shielding of Nuclear Reactor Systems:** Reactor Shielding Principles, Shielding Geometry Transformations, Attenuation of Radiations, Distributed Sources, Reactor Shielding, Comparison Method of Shield Design, Shielding by Anisotropic Medium, Shielding of Gamma-Ray Sources, Radiation Heating in Shields.
 |
| **CLO-2** | 1. **Reactor Parameters:** Introduction, the Diffusion of Neutrons, the Slowing Down of Neutrons, Slowing Down in Infinite Media, Spatial Distribution of Slowed Down Neutrons. Reflected Reactors, Homogeneous Reactor Systems, Heterogeneous Reactor Systems, Fast Reactors.
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|  | **Section-B** |
| **CLO-3** | 1. **Reactor Fuels:** Fuel Materials, Production of Reactor Fuels, Separation of Uranium Isotopes, Properties of Fuel- Element Materials, Reprocessing of Irradiated Fuel, Separation process, Process Waste Disposal.
 |
| **CLO-1** | 1. **Control and Energy Removal:** Design of the Control System, Reactor Kinetics, Effect of Temperature on Reactivity, Fission Product Poisoning, Reactor Control Instrumentation, Reactor Operation. Thermal Problems in Reactor Design, Design of Cooling Systems, Heat Transmission Principles, Heat Transmission in Systems with Internal Sources, Temperature Distribution along Path of Reactor Coolant, Heat- Transfer Characteristics of Fluids, Reactor Coolants.
 |
| **CLO-4** | 1. **Radiation Protection and Reactor Safeguards:** Radiation Hazards and Health Physics, Biological Effects of Radiation, Radiation Dose Units, Standards of Radiation Protection, Protection of Personnel, Reactor Safeguards.
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| **Recommended Books:** |
| 1. Nuclear Reactor Engineering Samuel Glasstone and Alexander Sesonske
2. Introduction to Nuclear Engineering Lamarsh, JR
3. Nuclear Power Systems King, DG
4. Elementary Introduction to Nuclear S. E. Liverhant
5. Reactor Physics
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| **Course Code:** MSE M2131 | **Course Title:** Functional Polymers |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof.Dr.M. Asadul Hoque Prof.Dr. Md. Abdul Matin |  |
| **Course Description:** Now a day’s functional polymers have attracted much attention of the researchers due to its diversified advanced application in medical, biomedical, electronic, energy conversion, military, aerospace, and commercial uses. In this course design, synthesis and purification of functional polymers will be discussed. Illustrative applications of functional polymers in electronic, magnetic, drug carrier and releasing, sensing, biomaterials, ion exchange, etc will be discussed. Different methods of nanostructure fabrication techniques with conductive functional polymer, metal-conductive polymer nanocomposites and conductive polymer encapsulated nanostructures will be demonstrated. The course will enhance the skill of materials science graduates for developing noble of functional polymers for future needs.  |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help the students for understanding design, synthesis, characterization and application of functional polymer in the field of electrical, magnetic and optical area.
2. Students will develop their skill on the nanoscale control of functional polymer for tuning the properties.
3. At the end of this course, the students will learn the preparation and functionalization of polymers, fabrications of nano- and micro-structured polymers, metal-polymer hybrid nano-structures, polymer in medical and biological application.
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| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Understand different aspects of functional polymer, their properties and applications.
2. Develop their skill on design, modifications, synthesis and purification of functional polymers.
3. Fabricate nanostructured functional polymer with nanoscale controlled features with tuning aspect ratios.
4. Prepared the electrical, optical and magnetic devices with suitable combinations of functional polymer.
5. Demonstrate the applications in medicine, agriculture and fire retardant.
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-1****CLO-2****CLO-3** | 1. **Introduction:** Definition and Classification, Design of Functional Polymers, Advantages and Limitations of Functional Polymers, Application.
 |
| **CLO-2****CLO-3** | 1. **Conducting Polymers**: Introduction, Structural Characteristics, Doping Concept and Conducting Mechanism, Synthetic Method and Formation Mechanism- Hard Template, Soft Template and other Methods, Conducting Nanostructure-Composite Nanostructures, Metal-Conducting Polymer Composite Nanostructures, Conducting Polymer/Carbon Nanotube Composites, Core-Shell Composites, Properties and Applications.
 |
| **CLO-3** | 1. **Polymer nanocomposites and polymer template for nanostructure:** Polymer Nanomaterials, Nanoparticles-Carbon Nanofiber, Polyhedral OligomericSilsesquioxane (POSS), Carbon Nanotube, Nanosilica, Block Copolymer Templating, Fabrication of Metal Nanostructure by Polymer Templating.
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|  | **Section-B** |
| **CLO-4** | 1. **Electrical, Magnetic and Optical Properties of Polymers:** Dielectric Behavior: Dielectric Coefficient, Mechanism of Dielectrical Polarization, Implications of Electrical and Thermal Loss in a Dielectric, Electrical Conductivity: Electrical Resistance, Physical Causes of Volume Conductivity, Application Problems: Electrical Breakdown, Electrostatic Charge,Electrets, Electromagnetic Interference Shielding (EMI shielding), Magnetic Properties: Magnetizability, Magnetic Resonance, OpticalProperties: Index of Refraction, Photoelasticity and Birefringence, Transparency, Reflection, Absorption, Transmittance, Gloss, Color.
 |
| **CLO-5** | 1. **Stimuli-responsive Polymers:** pH-Responsive Polymers, Temperature Responsive Polymers, Glucose-Responsive Polymers, Enzyme-Responsive, Molecularly Imprinted Polymers, Photo-Responsive Polymers, Electrically-Responsive Polymers, Shear Stress Responsive Polymers.
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| **CLO-4****CLO-5** | 1. **Functional Polymers in Advanced Applications:** Functional Polymers, Polyurethanes, Polymer-Bound Stabilizers, Antioxidants, Flame Retardants, Ultraviolet Stabilizers, Polymers in Controlled Drug Release, Degradable Polymers, Site-Directed (Targeted) Drug Delivery, Light Emitting Diodes (LEDs), Solar Cells, Rechargeable Batteries and Super Capacitors.
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| **Recommended Books:** |
| 1. Polymer Science and Technology R. O. Ebewel
2. Polymer Nanocomposites: Processing, Joseph H. Koo

Characterization and Applications1. Mechanical Properties of Polymers Based G. H. Michler, F. J. Belt Calleja

On Nanostructure and Morphology1. Conducting Polymers with Micro or Meixiang Wan

Nanometer Structure1. Materials Science of Polymers for Engineers Tim A. Osswald and Georg Menges
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| **Course Code:** MSE M2141 | **Course Title:** Biomaterials |
| **Course Credit:** 3 |  |  |
| **Course Teacher:** Prof.Dr. G. M. Shafiur Rahman Prof.Dr. Abu Mahmud |  |
| **Course Description:** A biomaterial is a synthetic material used to replace part of a living system or to function in intimate contact with living tissue and the discipline involved is called biomaterials science. This science was born to fulfil the demands of patients and physicians for more efficient as well as new products. Biomaterials science is multidisciplinary because it needs the support of many classical disciplines, including physics, chemistry, biology, engineering and medicine. This course is intended to provide an overview of theory and practice of biomaterials science. |
| **Course Objectives (Intended Learning Objectives, ILOs):** |
| 1. This course will help the students to critically choose, fabricate and analyse different types of materials that can be applied as biomaterials in different parts of human body.
2. They can select and modify materials according to specific biological response.
 |
| **Course Learning Outcome (CLO):**After successfully completion this course the students should be able to: |
| 1. Understand the scientific Knowledge of biomaterials
2. Biomaterials for specific need of human body
3. Synthesis, fabrication existing biomaterials
4. Design and modify of biomaterials
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| **Learning Outcomes** | **Course content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|  | **Section-A** | LectureExercise/Tutorial/quizAttendance | Full Marks: 75Attendance:10%Tutorial/Quiz:20%Exam: 70% |
| **CLO-1** | 1. **Concept of Biomaterials:** Introduction, Historical Development, Construction Materials, Impact, Strength of Biological Tissue, Performance of Implants, Tissue Response to Implants, Interfacial Phenomena, Safety and Efficacy Testing.
 |
| **CLO-2****CLO-3** | 1. **Metallic and Ceramics Biomaterials:** Stainless Steels, Cobalt-Chromium Alloys, Titanium Based Alloys, Nitinol, other metals, Carbon and Alumina, yttria Stabilized Zirconia, Surface Reactive Ceramics, Resorbable Ceramics, Composites, Corrosion and Biological Tolerance of Implants.
 |
| **CLO-2****CLO-3** | 1. **Biopolymers:** Polymer in Biomedical uses, Polyethylene and Polypropylene, Perfluorinated Polymers, Acrylic Polymers, Hydrogels, Polyurethanes and Polyamides, Biodegradable Polymers, Silicon Rubber, PlasmaPolymerization, Collagens and Elastin, Mucopolysaccharides, Proteoglycans, Cellulose and Derivatives, Chitin, Microorganisms in Polymeric Implants, Polymer Sterilization.
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| **CLO-2****CLO-3****CLO-4** | 1. **Orthopedic Implants:** Bone Composition and Properties, Temporary Fixation Devices, Fracture Healing by Electrical and Electromagnetic Stimulation, Joint Replacement, Knee Joint Repair, Bone Generation with Resorbable Materials
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|  | **Section-B** |
| **CLO-2****CLO-3****CLO-4** | 1. **Materials for drug delivery, sutures and biosensors:** Diffusion controlled drug delivery system, water penetration system, chemically controlled devices, bio-erodible matrix systems; self-regulated delivery systems, categories and characteristics of sutures, suture development, definition and classification of biosensors, working mechanisms of biosensors, materials for biosensors.
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| **CLO-2****CLO-3** | 1. **Cardiovascular Implants and Extracorporeal Devices:** Blood Clotting, Rheology and Vessels, Heart, Aorta and Valves, Geometry of Circulation, Lungs, Vascular Implants, Cardiac Pacemaker, Blood Substitute, Kidney Function, Water in Human Body, Extracorporeal Blood Circulation Devices.
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| **CLO-2****CLO-3** | 1. **Biomaterials in Ophthalmology:** Eye Anatomy,Viscoelastic Solutions, Contact Lenses, Optical Implants, Drainage tubes in Glaucoma, Scleral Buckling Materials for Retinal Detachment, Vitreous Implants, Acrylate Adhesives, Eye Shields, Artificial Tears.
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| **CLO-2****CLO-3** | 1. **Dental Materials:** Tooth Composition and Mechanical Properties, Impression Materials, Bases, liners and Varnishes forCavities, Filling and Restorative Materials, Materials for Deep Cavities, Metals in Dentistry, Oral Implants, Use of Collagen in Dentistry.
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| **Recommended Books:** |
| 1. Biomaterials S. V. Bhat
2. Biomaterials of the Muskulo-Skeletal Systems B.M. Nigg and W. Herzog
3. Handbook of Biomedical Engineering Kline
4. Biocompatibility of Orthopaedic Implants D. F. Williams
5. Modern Physical Metallurgy and R.E. Smallman and R.J. Bishop

Materials Engineering |
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**MSE M2110Board Viva-voce**

**Unit: 0.5, credits: 2, full marks: 50**

**3rd Semester Examination 2023**

**MSE M3112 Thesis**

**Unit: 2, Credits: 8, Full Marks: 200**

**MSE M3110Thesis Viva-voce**

**Unit: 1, credits: 4, full marks: 100**