BACHELOR OF SCIENCE

IN

MATERIALS SCIENCE

(Applicable from the academic session 2019-2020)

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Haringhata-741249, Nadia, West Bengal, INDIA

Preamble:

Department of Materials Science and Technology under School of Natural and Applied Sciences of Maulana Abul Kalam Azad University of Technology West Bengal (MAKAUT) is introducing a three years Bachelors Course in Materials Science (BSc- Materials Science), with an **emphasis on computational techniques associated with Materials Science and Technology and Nanomaterials**. The under graduate syllabus has been designed following the recommendations and guidelines of University Grants Commission (UGC) according to the Semester Wise Choice Based Credit System (CBCS) scheme. The contents, structure and date of effect of the proposed syllabus will be decided by the board of studies (B.O.S) of the department following its acceptance and approval.

Purpose:

The B.Sc. Course is systematically designed where students shall be trained on the fundamentals of Physics, Chemistry Mathematics, and Computational Techniques required for understanding and designing of materials. During framing of this syllabus for B.Sc. (Honours) in Materials Science, substantial weightage has been given in both the core subjects as well as skill and ability enhancement of the students. The ultimate goal of the syllabus is to enable the students to have an in-depth knowledge of the subject/s and enhance their scope of employment in the industry. **The programme shall also enable students to develop a deep understanding of various aspects of computational materials science**.

Structure of the Course:

First year of under-graduate study (Semester I &II): During the first two semesters students shall be exposed with six core courses, giving emphasis on basic sciences and mathematics to teach materials behaviour: atomic bonding, thermodynamics, mechanics, and crystal defects. Along with these core courses, special emphasis shall be given to make students digitally equipped. They will learn to handle **computational software** and tool like **MATLAB along with programming language C, Python.**

Second year of under-graduate study (Semester III &IV): The scientific foundation shall be further strengthened by a strong curriculum content consisting of courses in**:** Kinetics of Materials and Transport Phenomena, Materials Behaviour: Mechanical, Electrical & Magnetic, Structure of Materials and processing of materials. A vibrant set of skill enhancement elective (Basics of Artificial Intelligence; Basics of Block Chain Technology, Basics of IOT, Basics of AR/VR) and generic elective (Thinking and Acting like an Entrepreneur; Disciplined approach to Social Entrepreneurship) courses shall give the students flexibility and exposure to some other discipline/subject/domain which would improve candidate's employability. Tutorials and laboratories will complement lectures.

Third year of under-graduate study (Semester V &VI): The core course is specially designed giving adequate emphasis on the new and emerging techniques and understanding of the materials science under the changing regime and global context. The summers are about giving an exposure to practice: materials research through mini-projects, as well as industrial visits.

Special care shall be taken for developing entrepreneurship capacity building and excellent opportunity shall be provided to improve extra-curricular and leadership skills.

The final year project is a key part of the curriculum, this can be chosen from a variety of topics given to the students or even students may implement their ideas into practice. Students will get to work on exciting research ideas ranging from designing/synthesis of materials to applications both by experimental and computational techniques. The summers are about giving an exposure to practice materials research through mini-projects, as well as industrial visits.

Precedence:

During the design of the syllabus, we have to referred the syllabi of some National and International Universities, the names of the institutes are placed hereunder:

National Universities

1. IISC Bangalore- B.Sc (Research) in Materials (Consulted for the course pattern and subjects of Materials Science)

2. Calcutta University, West Bengal (Consulted for CBCS structure of B.Sc (H) course and for the subject for basic Physical Science)

3. Delhi University, Delhi (Consulted for CBCS structure of B.Sc (H) course and for the subject for basic Physical Science)

4. IIT Kharagpur, West Bengal (Consulted for the course pattern and subjects of Materials Science)

International Universities/Institutes

1. University of Manchester-UK (Consulted for the subjects of Materials Science))

2. MIT-USA (Consulted for the subjects of Materials Science)

3. Illinois Institute of Technology, USA (Consulted for the course pattern and subjects of Materials Science)

4. Wright State University, USA (Consulted for the course pattern and subjects of Materials Science)

As per the rules of MAKAUT WB, a total of 120 credit points has to be earned by the student to obtain the degree of B.Sc (General) in Materials Science while further 20 credit has to be earned from online MOOCs (Massive Open Online Courses) offered by Coursera, edX, SWAYAM/nptel, nanoHub etc. to get the degree of B.Sc (Honours) in Materials Science.

Hope the proposed curriculum will make it more contextual, viable and suitable to cater the needs of students of Materials Science

Eligibility Criteria: 10+2 Pass-out from any board with Physics/Chemistry, Mathematics/Statistics, Computer Science subject combination. Cut-off marks will be decided by the competent authority.

Duration of the Course: 3 years

Student Intake: 30

OUTLINE OF CHOICE BASED CREDIT SYSTEM

1. Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. Elective Course: Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. Ability Enhancement Courses (AEC): The Ability Enhancement (AE) Courses may be of two kinds: **Ability Enhancement Compulsory Courses (AECC)** and **Skill Enhancement Courses (SEC).** "**AECC**" courses are the courses based upon the content that leads to Knowledge enhancement;

i. Environmental Science and **ii. English/MIL Communication**. These are mandatory for all disciplines. **SEC** courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

- Introducing Research Component in Under-Graduate Courses

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analysing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Maulana Abul Kalam Azad University of Technology, West Bengal
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BACHELOR OF SCIENCE IN MATERIALS SCIENCE
Curriculum Structure

Semester-I							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total no of contact hours**			**Credits**
				L	T	P	
Theory							
1	Core Course I	BMS101	Introduction to Materials	3	1	0	4
2	Core Course II	BMS102	Classical Physics for Materials Science	3	1	0	4
3	Core Course III	BMS103	Mathematics I: Vector & Calculus	3	1	0	4
4	Generic Elective I	BMS104	Statistical Methods for Materials Science - I	3	1	0	4
Total Theory				12	4	0	16
Practical							
1	Laboratory I	BMS191	Macroscopic and Microscopic Examination of Materials	0	0	4	2
2	Laboratory II	BMS192	Introduction to Programming using C and MATLAB	0	0	4	2
Total Practical				0	0	8	4
Sessional							
1	Ability Enhancement Compulsory Course (AECCI)	BMS 105	Communicative English	2	0	0	2
			Total of Semester-I	14	4	8	22

Semester-II							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total no of contact hours**			**Credits**
				L	T	P	
Theory							
1	Core Course IV	BMS201	Quantum Physics for Materials Science	3	1	0	4
2	Core Course V	BMS202	Materials Chemistry	3	1	0	4
3	Core Course VI	BMS203	Mathematics II: Linear Algebra	3	1	0	4
4	Generic Elective II	BMS204	Statistical Methods for Materials Science-II	3	1	0	4
5	Elective III	BMS205	From MOOCs Basket	3	0	0	3
Total Theory				15	4	0	19
Practical							
1	Laboratory I	BMS291	Materials Synthesis Lab	0	0	4	2
2	Laboratory II	BMS292	Data Analysis, Visualization and Interpretation using MATLAB	0	0	4	2
Total Practical				0	0	8	4
Sessional							
1	Ability Enhancement Compulsory Course (AECCII)	BMS 206	Environment & Sustainability	2	0	0	2
			Total of Semester-II	17	4	8	25

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
BACHELOR OF SCIENCE IN MATERIALS SCIENCE

Semester-III							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total no of contact hours**			**Credits**
				L	T	P	
Theory							
1	Core Course VII	BMS301	Thermodynamics of Materials	3	1	0	4
2	Core Course VIII	BMS302	Kinetics of Materials and Transport Phenomena	3	1	0	4
3	Core Course IX	BMS303	Structure of Materials	3	1	0	4
4	Generic Elective III	BMS304	Thinking and Acting like an Entrepreneur	3	0	0	3
5	Elective IV	BMS305	From MOOCs Basket	3	0	0	3
Total Theory				15	3	0	18
Practical							
1	Laboratory I	BMS391	Introduction to Programming using Python	0	0	4	2
2	Laboratory II	BMS392	Introduction to Finite Element Analysis	0	0	4	2
Total Practical				0	0	8	4
Sessional							
1	Skill Enhancement Course I(A/B/C/D)	BMS 306	SEC– I (Choose either of A/B/C/D from the corresponding table)	2	0	0	2
Total of Semester-III				17	3	8	24

Semester-IV							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total no of contact hours**			**Credits**
				L	T	P	
Theory							
1	Core Course X	BMS401	Phase Equilibria and Phase Transformation	3	1	0	4
2	Core Course XI	BMS402	Materials Behavior: Mechanical, Electrical & Magnetic	3	1	0	4
3	Core Course XII	BMS403	Processing of Bulk Materials	3	1	0	4
4	Generic Elective IV	BMS404	Disciplined approach to Social Entrepreneurship	2	0	4	4
5	Elective V	BMS405	From MOOCs Basket	3	0	0	3
Total Theory				14	3	4	19
Practical							
1	Laboratory I	BMS491	Intermediate Programing with Python	0	0	4	2
2	Laboratory II	BMS492	Materials Behavior Lab	0	0	4	2
Total Practical				0	0	8	4
Sessional							
1	Skill Enhancement Course II(A/B/C/D)	BMS 406	SEC– II (Choose either of A/B/C/D except the course chosen in SEC-I from the corresponding table)	2	0	0	2
Total of Semester-IV				16	3	12	25

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BACHELOR OF SCIENCE IN MATERIAL SCIENCE

Curriculum Structure

Semester-V							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total no of contact hours**			**Credits**
				L	T	P	
Theory							
1	Core Course XIII	BMS501	Thin films and Nano Materials	3	1	0	4
3	Core Course XIV	BMS502	Materials Behavior: Electronic and Optical	3	1	0	4
2	Discipline Specific Elective I (A/B/C/D/E/F)	BMS503	DSE – 1 (Choose either of A/B/C/D/E/F from the corresponding table)	3	0	0	3
4	Discipline Specific Elective II	BMS504	DSE II– (From MOOCs Basket)	6	-	-	6
Total Theory				15	2	0	17
Practical							
1	Laboratory I	BMS591	Nano-Materials Lab	0	0	4	2
Total Practical				0	0	4	2
Sessional							
1	Elective Course	BMS581	Project Work	0	0	6	3
Total of Semester-V				15	2	10	22

Semester-VI							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total no of contact hours**			**Credits**
				L	T	P	
Theory							
1	Core Course XV	BMS601	Materials Characterization	3	1	0	4
2	Core Course XVI	BMS602	Design and Selection of Materials	3	0	2	4
3	Discipline Specific Elective III (A/B/C/D/E/F)	BMS603	DSE – III (Choose either of A/B/C/D/E/F except the course chosen in DSE I from the corresponding table)	3	0	0	3
3	Discipline Specific Elective IV	BMS604	DSE IV– (From MOOCs Basket)	6	-	-	6
Total Theory				15	1	2	17
Practical							
2	Laboratory I	BMS692	Materials Characterization Lab	0	0	4	2
Total Practical				0	0	4	2
Sessional							
1	Elective Course	BMS681	Project Work	0	0	6	3
Total of Semester-VI				15	1	12	22

SEM	Core Course (16) 84 credit courses	Ability Enhancement Compulsory Course (AECC) (2) 4 credit courses	Skill Enhancement Course (SEC) (2) 4 credit courses	Elective : Discipline Specific (DSE) (4) 24 credit courses	Elective: Generic (4) 24 credit courses
				Out of 48 credit under elective course, a student has to earn 20 credit from MOOCs basket	
I (22)	**C1:** Introduction to Materials **(4)**	Communicative English **(2)**			Statistical Methods for Materials Science – I **(4)**
	C2: Classical Physics for Materials Science **(4)**				
	C3: Mathematics I: Vector & Calculus **(4)**				
	Lab I (2)				
	Lab II (2)				
II (25)	**C1:** Quantum Physics for Materials Science **(4)**	Environment & Sustainability **(2)**			Statistical Methods for Materials Science-II **(4)**
	C2: Materials Chemistry **(4)**				
	C3: Mathematics II: Linear Algebra **(4)**				From MOOCs Basket **(3)** credit courses
	Lab I (2)				
	Lab II (2)				
III (24)	**C1:** Thermodynamics of Materials **(4)**		(A) Basics of AI; (B) Basics of Block Chain Technology, (C) Basics of IOT, (D) Basics of AR/VR **(2)** *(Choose either of A/B/C/D from the corresponding table)*		Thinking and Acting like an Entrepreneur **(4)**
	C2: Kinetics of Materials and Transport Phenomena **(4)**				
	C3: Structure of Materials **(4)**				From MOOCs Basket **(3)** credit courses
	Lab I (2)				
	Lab II (2)				
IV (25)	**C1:** Phase Equilibria and Phase Transformation **(3)**		(A) Basics of AI; (B) Basics of Block Chain Technology, (C) Basics of IOT, (D) Basics of AR/VR **(2)** *(Choose either of A/B/C/D except the course chosen in SEC-I from the*		Disciplined approach to Social Entrepreneurship **(4)**
	C2: Materials Behavior: Mechanical, Electrical & Magnetic **(4)**				
	C3: Processing of Bulk Materials **(4)**				From MOOCs Basket **(3)** credit courses
	Lab I (2)				
	Lab II (2)				

			corresponding table)		
V (22)	**C1:** Thin films and Nano Materials **(4)**			(A) Metallic Materials, (B) Polymeric Materials, (C)Ceramic Materials, (D) Composites Materials, (E) Bio materials, (F) Energy Materials **(3)** *(Choose either of A/B/C/D/E/F from the corresponding table)*	
	C2: Materials Behavior: Electronic and Optical **(4)**			DSE II From MOOCs Basket **(6 = 2+2+2 or 3+3)** credit courses	
	Lab I (2)			Project Work **(3)**	
VI (22)	**C1:** Materials Characterization **(4)**			(A) Metallic Materials, (B) Polymeric Materials, (C)Ceramic Materials, (D) Composites Materials, (E) Bio materials, (F) Energy Materials **(3)** *(Choose either of A/B/C/D/E/F except the course chosen in DSE-I from the corresponding table)*	
	C2: Design and Selection of Materials **(4)**			DSE III From MOOCs Basket **(6 = 2+2+2 or 3+3)** credit courses	
	Lab I (2)			Project Work **(3)**	

LIST OF ELECTIVES

SEC courses for SEMESTER –III (BMS 306)

Sl. No.	Course Name	Course Provider	Course Duration	Credits	Name of University/Institute
A	Introduction to Artificial Intelligence	edX	4 weeks	2	Microsoft
B	Basics of Internet Of Things (IOT)	coursera	4 weeks	2	University of California, Irvine
C	Basics of Block Chain Technology (BCT)	coursera	4 weeks	2	Association of International Certified Professional Accountants
D	Introduction to XR: VR, AR, and MR Foundations	coursera	4 weeks	2	Unity Technologies

SEC courses for SEMESTER –IV (BMS 406)

Sl. No.	Course Name	Course Provider	Course Duration	Credits	Name of University/Institute
A	Introduction to Artificial Intelligence	edX	4 weeks	2	Microsoft
B	Basics of Internet Of Things (IOT)	coursera	4 weeks	2	University of California, Irvine
C	Basics of Block Chain Technology (BCT)	coursera	4 weeks	2	Association of International Certified Professional Accountants
D	Introduction to XR: VR, AR, and MR Foundations	coursera	4 weeks	2	Unity Technologies

DSE courses for SEMESTER –V (BMS 503)

Sl. No.	Course Name
A	Metallic Materials
B	Polymeric Materials
C	Ceramic Materials
D	Composite Materials
E	Bio Materials
F	Energy Materials

DSE courses for SEMESTER –VI (BMS 603)

Sl. No.	Course Name
A	Metallic Materials
B	Polymeric Materials
C	Ceramic Materials
D	Composite Materials
E	Bio Materials
F	Energy Materials

MOOC'S BASKET

For Honours degree student earn minimum of 140 credits in 3 years *[out of which up to maximum 20 credits may be earned from the MOOCs basket]*

Sl. No.	Course Name	Course Provider	Course Duration	Credits	Name of University/Institute
1	Materials Science: 10 Things Every Engineer Should Know	Coursera	5 weeks	2	University of California, Davis
2	Computational Materials Science	nanoHUB	6 weeks	2	University of Illinois
3	Computational Approach to Materials Science and Engineering	NPTEL	6 weeks	2	IIT Bombay
4	Principles of Machine Learning	edx	6 weeks	2	Microsoft
5	Introduction to High Throughput Materials	Coursera	4 weeks	2	Georgia Institute of Technology
6	Materials in Oral Health	Coursera	4 weeks	2	University of Hong Kong
7	Medical Biomaterials	NPTEL	8 weeks	3	IIT Madras
8	Introduction to Physical Chemistry	Coursera	10 weeks	3	The University of Manchester
9	Introduction to Python for Data Science	edx	6 weeks	2	Microsoft
10	Using Python for Research	edx	12 weeks	4	Harvard University
11	Waste to Energy Conversion	NPTEL	8 weeks	3	IIT Roorkee
12	Fundamental concepts of semiconductors	NPTEL	6 weeks	2	IIT Delhi
13	Diffusion in Multicomponent Solids	NPTEL	12 weeks	3	IIT Kanpur
14	Physics of Materials	NPTEL	8 weeks	3	IIT Madras
15	Optoelectronics Materials and Devices	NPTEL	8 weeks	3	IIT Kanpur
16	Nanotechnology and Nanosensors, Part1	Coursera	5 weeks	2	Technion – Israel Institute of Technology
17	Nanotechnology and Nanosensors, Part 2	Coursera	5 weeks	2	Technion – Israel Institute of Technology
18	Nature and Properties of Materials	NPTEL	8 weeks	3	IIT Kanpur

Marking Scheme followed for evaluation of student's performance

Theory = 100; Laboratory = 100

Distribution of Marks for Theory paper

Each Theory paper marks (100) is divided as = 70 (End Semester Examination) + 30 (Continuous Assessment)

Theory (100)

70
(End Semester Examination)
End Semester Examination will be held in the month of December for Odd Semester and in the month of May for Even semester on schedules dates as notified by COE.

30
(Continuous Assessment)
(15 + 5 + 5 + 5)
15 (Internal Test)
5 (Attendance)
5 (Quiz)
5 (Class Assignment)

Marks distribution (of Theory paper) and Question Paper pattern followed in MAKAUT WB in all departments for End semester Examination

Sl. No.	Question Type	No. of Questions	No. of Questions have to attend	Marks Allotted	Total
1.	MCQ	1 (a - j) = 10	10 (All are compulsory)	1 mark each	1 * 10 = 10 marks
2.	Short Answer Type	2 to 7 = 6	3 out of 6	3 marks each	3 * 5 = 15 marks
3.	Long Answer Type	8 to 13 = 6	3 out of 6	15 marks each	3 * 15 = 45 marks
				Total marks	(10+15+45) = 70

Distribution of Marks for Laboratory

Each Laboratory marks (100) is divided as = 60 (End Semester Examination) + 40 (Internal Assessment)

Laboratory (100)

60 marks
(End Semester Examination) (External)

2 Experiments to be performed
or
2 Computer programs to be written
30 marks
Duration of Exam: 3 hours
10 marks: Viva (to judge the concept of the student)
15 marks: Lab copy
5 marks: Attendance

40 marks
(Internal Assessment)

25 marks: For experiments performed (in whole Semester)
5 marks: Viva Voice
5 marks: Lab copy maintenance
5 marks: Attendance

Distribution of marks for attendance

Sl. No.	Attendance Range	Marks to be allotted
1	75% >	1
2	80% >	2
3	85% >	3
4	90%	4
5	90% >	5

Grading System

Sl. No.	Range of Marks	Letter Grade	Marks
1	40-50	D(Pass)	5
2	50-60	C (Average)	6
3	60-70	B (Good)	7
4	70-80	A (Very good)	8
5	80-90	E (Excellent)	9
6	90-100	O (Outstanding)	10
7	Less than 40	Fail	
8	--	Absent	0