University of Mumbai

No. UG/ 54 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to this office circular No. UG/164 of 2017-18 dated 8th August, 2017 relating to the revised syllabus as per the (CBCS) for Bachelor of Engineering (Biomedical Engineering) Sem.III & VIII be revised S.E. (Sem.III & IV) from Academic Year 2017-18, Third Year (Sem.V & VI) from Academic Year 2018-19 and Bachelor of Engineering (Sem. VII & VIII) from Academic Year 2019-20.

They are hereby informed that the recommendations made by the Board of Studies in Biomedical Engineering at its meeting held on 20th April, 2020 and subsequently made by the Board of Deans at its meeting held on 20th July, 2020 vide item No. 13 have been accepted by the Academic Council at its meeting held on 23rd July, 2020 **vide** item No. 4.140 and that in accordance therewith, the revised scheme (Rev-2019 'C' Scheme) for the B.E. in Biomedical Engineering (Sem.III to VIII) has been brought into force with effect from the academic year 2020-21. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
21st January, 2021

(Dr. B.N.Gaikwad)
I/c REGISTRAR

To

The Principals of the Affiliated Colleges, and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.140/23/07/2020

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No. UG/ 54 -A of 2021 MUMBAI-400 032 21st January, 2021

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Biomedical Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-ordinator, University Computerization Centre,

(Dr. B.N.Gaikwad)
I/c REGISTRAR

Copy to :-

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publication Section),**
7. **The Deputy Registrar, (Special Cell),**
8. **The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
9. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. **P.A to Hon'ble Vice-Chancellor,**
2. **P.A Pro-Vice-Chancellor,**
3. **P.A to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A to Finance & Account Officers, (F.& A.O),**
6. **P.A to Director, Board of Examinations and Evaluation,**
7. **P.A to Director, Innovation, Incubation and Linkages,**
8. **P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Walfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-Campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA**

for information.

AC: 23/07/2020
Item No.: 140

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Biomedical Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

Member, Academic Council, RRC in Engineering

University of Mumbai

Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of ‘C ‘ scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD’s/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

Member, Academic Council, RRC in Engineering

University of Mumbai

Preface By BoS

Engineering is an innovative field, the origin of ideas leading to everything from automobile to aerospace, skyscrapers to sonar. **Biomedical Engineering** focuses on the advances that improve human health and health care at all levels. Biomedical engineering is an interdisciplinary field with application of the principles of Basic Sciences, Mathematics, Engineering fundamentals and Biology for problem-solving.

The curriculum is designed to meet the challenges by include new age courses on Machine Learning, Artificial Intelligence, Data Analytics and other emerging technologies, dismantling the walls between engineering and scientific disciplines. The key to generate a new paradigm shift for careers in Biomedical Engineering for the next generation of talented minds lies in imparting high-quality education in Engineering.

Every course in the curriculum lists the course objectives and course outcomes for the learners to understand the skills that the learner will acquire after completing that course. Program outcomes are the skills and knowledge that a student will acquire during the course of four years of this engineering program. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Biomedical Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for undergraduate program were thoughtfully framed by faculty members from different affiliated institutes of the university. They are Heads of Departments and senior representatives from the Department of Biomedical Engineering.

The Program Educational Objectives for the undergraduate program in Biomedical engineering are listed below;

1. To prepare the learner with a sound foundation in the Human Physiology, Mathematics, Electronics, Computer Programming and engineering fundamentals.

2. To motivate the learner for self-learning, logical & analytical thinking and use of modern tools for solving real life problems.

3. To impart technical knowledge, competency skills, professional and ethical attitude, good leadership qualities to contribute in the field of healthcare.

4. To prepare the Learner for a successful career in healthcare industry such as sales & marketing, research & development, hospital administration and also to venture into higher education and entrepreneurship.

Board of Studies in Biomedical Engineering

Dr. Manali J. Godse : Chairman

Dr. Prem C. Pandey : Member

Dr. Mita Bhowmick : Member

Dr. Mrunal R. Rane : Member

Dr. Vaibhavi A. Sonetha : Member

Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
BMC301	Engineering Mathematics – III	3	--	1	3	--	1	4
BMC302	Human Anatomy and Physiology for Engineers	3		--	3		--	3
BMC303	Medical Sensors	3	--	--	3	--	--	3
BMC304	Electronic Circuits Analysis and Design	4	--	--	4	--	--	4
BMC305	Digital Electronics	3	--	--	3	--	--	3
BML301	Human Anatomy and Physiology for Engineers Lab	--	2	--	--	1	--	1
BML302	Medical Sensors Lab	--	2	--	--	1	--	1
BML303	Electronic Circuits Analysis and Design Lab	--	2	--	--	1	--	1
BML304	Electronics Lab (SBL)	--	4	--	--	2	--	2
BMM301	Mini Project – 1 A	--	4[$]	--	--	2	--	2
Total		**16**	**14**	**1**	**16**	**07**	**1**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					**Term Work**	**Pract/ oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam. Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg.**					
BMC301	Engineering Mathematics - III	20	20	20	80	3	25	--	125
BMC302	Human Anatomy and Physiology for Engineers	20	20	20	80	3	--	--	100
BMC303	Medical Sensors	20	20	20	80	3	--	--	100
BMC304	Electronic Circuits Analysis and Design	20	20	20	80	3	--	--	100
BMC305	Digital Electronics	20	20	20	80	3	--	--	100
BML301	Human Anatomy and Physiology for Engineers Lab	--	--	--	--	--	25	--	25
BML302	Medical Sensors Lab	--	--	--	--	--	25	25	50
BML303	Electronic Circuits Analysis and Design Lab	--	--	--	--	--	25	25	50
BML304	Electronics Lab (SBL)	--	--	--	--	--	25	25	50
BMM301	Mini Project – 1 A	--	--	--	--	--	25	--	25
Total		**--**	**--**	**100**	**400**	**--**	**150**	**75**	**725**

$ indicates work load of Learner (Not Faculty), for Mini Project - 1 A.
Faculty Load :1 hour per week per 4 mini project groups.

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
BMC401	Engineering Mathematics – IV	3	--	1	3	--	1	4
BMC402	Integrated Circuit Design	3	--	--	3	--	--	3
BMC403	Principles of Control Systems	3	--	--	3	--	--	3
BMC404	Medical Imaging – I	3	--	--	3	--	--	3
BMC405	Biomaterials and Artificial Organs	3	--	--	3	--	--	3
BML401	Integrated Circuit Design Lab	--	2	--	--	1	--	1
BML402	Principles of Control Systems Lab	--	2	--	--	1	--	1
BML403	Medical Imaging – I Lab	--	2	--	--	1	--	1
BML404	Computing Lab (SBL)	--	4	--	--	2	--	2
BMM401	Mini Project – 1 B	--	4$	--	--	2	--	2
Total		**15**	**14**	**1**	**15**	**7**	**1**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
BMC401	Engineering Mathematics - IV	20	20	20	80	3	25	--	125
BMC402	Integrated Circuit Design	20	20	20	80	3	--	--	100
BMC403	Principles of Control Systems	20	20	20	80	3	--	--	100
BMC404	Medical Imaging – I	20	20	20	80	3	--	--	100
BMC405	Biomaterials and Artificial Organs	20	20	20	80	3	--	--	100
BML401	Integrated Circuit Design Lab	--	--	--	--	--	25	25	50
BML402	Principles of Control Systems Lab	--	--	--	--	--	25	--	25
BML403	Medical Imaging – I Lab	--	--	--	--	--	25	25	50
BML404	Computing Lab (SBL)	--	--	--	--	--	25	25	50
BMM401	Mini Project – 1 B	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**150**	**100**	**750**

$ indicates work load of Learner (Not Faculty), for Mini Project - 1 B

Faculty Load :1 hour per week per 4 mini project groups.

Program Structure for Third Year Engineering
Semester V & VI
UNIVERSITY OF MUMBAI
(With Effect from 2021-2022)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
BMC501	Biomedical Instrumentation – I	3	--	3	--	3
BMC502	Digital Signal Processing	3	--	3		3
BMC503	Microcontrollers and Embedded Systems	4	--	4	--	4
BMC504	Medical Imaging – II	3	--	3	--	3
BMDO501X	Department Optional Course – 1	3	--	3	--	3
BML501	Biomedical Instrumentation – I Lab	--	2	--	1	1
BML502	Digital Signal Processing Lab	--	2	--	1	1
BML503	Microcontrollers and Embedded Systems Lab	--	2	--	1	1
BML504	Business Communication and Ethics	--	2*+2	--	2	2
BMM501	Mini Project – 2 A	--	4$	--	2	2
Total		**16**	**14**	**16**	**07**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC501	Biomedical Instrumentation – I	20	20	20	80	3	--	--	100
BMC502	Digital Signal Processing	20	20	20	80	3	--	--	100
BMC503	Microcontrollers and Embedded Systems	20	20	20	80	3	--	--	100
BMC504	Medical Imaging – II	20	20	20	80	3	--	--	100
BMDO501X	Department Optional Course – 1	20	20	20	80	3	--	--	100
BML501	Biomedical Instrumentation – I Lab	--	--	--	--	--	25	25	50
BML502	Digital Signal Processing Lab	--	--	--	--	--	25	25	50
BML503	Microcontrollers and Embedded Systems Lab	--	--	--	--	--	25	25	50
BML504	Business Communication and Ethics	--	--	--	--	--	25	25	50
BMM501	Mini Project – 2 A	--	--	--	--	--	25	--	25
Total		**--**	**--**	**100**	**400**	**--**	**125**	**100**	**725**

* Theory class to be conducted for full class
$ indicates work load of Learner (Not Faculty), for Mini Project - 2 A
Faculty Load :1 hour per week per 4 mini project groups.

Sem. V: Department Optional Course – 1

BMDO5011: Principles of Communication Engineering
BMDO5012: Very Large Scale Integration
BMDO5013: Tissue Engineering

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. /Tut.	Theory	Pract.	Total
BMC601	Biomedical Instrumentation – II	3	--	3	--	3
BMC602	Biomedical Digital Image Processing	3	--	3		3
BMC603	Data Analysis in Healthcare	3	--	3	--	3
BMC604	Biomechanics, Prosthetics and Orthotics	3	--	3	--	3
BMDO601X	Department Optional Course – 2	3	--	3	--	3
BML601	Biomedical Instrumentation - II	--	2	--	1	1
BML602	Biomedical Digital Image Processing	--	2	--	1	1
BML603	Data Analysis in Healthcare	--	2	--	1	1
BML604	Automation Lab	--	4	--	2	2
BMM601	Mini Project – 2 B	--	4$	--	2	2
Total		**15**	**14**	**15**	**07**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC601	Biomedical Instrumentation - II	20	20	20	80	3	--	--	100
BMC602	Biomedical Digital Image Processing	20	20	20	80	3	--	--	100
BMC603	Data Analysis in Healthcare	20	20	20	80	3	--	--	100
BMC604	Biomechanics, Prosthetics and Orthotics	20	20	20	80	3	--	--	100
BMDO601X	Department Optional Course – 2	20	20	20	80	3	--	--	100
BML601	Biomedical Instrumentation – II Lab	--	--	--	--	--	25	25	50
BML602	Biomedical Digital Image Processing Lab	--	--	--	--	--	25	25	50
BML603	Data Analysis in Healthcare Lab	--	--	--	--	--	25	--	25
BML604	Automation Lab	--	--	--	--	--	25	25	50
BMM601	Mini Project – 2 B	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**125**	**100**	**725**

$ indicates work load of Learner (Not Faculty), for Mini Project - 2 B

Faculty Load :1 hour per week per 4 mini project groups.

Sem. VI: Department Optional Course – 2

BMDO6011: Nuclear Medicine

BMDO6012: Advanced Embedded Systems

BMDO6013: Telemedicine

Program Structure for Fourth Year Engineering
Semester VII & VIII
UNIVERSITY OF MUMBAI
(With Effect from 2022-2023)

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. Tut.	Theory	Pract.	Total
BMC701	Biomedical Instrumentation – III	3	--	3	--	3
BMC702	Machine Learning	3	--	3		3
BMDO701X	Department Optional Course – 3	3	--	3	--	3
BMDO702X	Department Optional Course – 4	3	--	3	--	3
BMIO701	Institute Optional Course – 1	3	--	3	--	3
BML701	Biomedical Instrumentation – III Lab	--	2	--	1	1
BML702	Machine Learning Lab	--	2	--	1	1
BML703	Department Optional Course – 3 Lab	--	2	--	1	1
BMP701	Major Project - I	--	6#	--	3	3
Total		**15**	**12**	**15**	**6**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/ oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC701	Biomedical Instrumentation – III	20	20	20	80	3	--	--	100
BMC702	Machine Learning	20	20	20	80	3	--	--	100
BMDO701X	Department Optional Course – 3	20	20	20	80	3	--	--	100
BMDO702X	Department Optional Course – 4	20	20	20	80	3	--	--	100
BMIO701	Institute Optional Course – 1	20	20	20	80	3	--	--	100
BML701	Biomedical Instrumentation – III Lab	--	--	--	--	--	25	25	50
BML702	Machine Learning Lab	--	--	--	--	--	25	25	50
BML703	Department Optional Course – 3 Lab	--	--	--	--	--	25	25	50
BMP701	Major Project - I	--	--	--	--	--	50	--	50
Total		**--**	**--**	**100**	**400**	**--**	**125**	**75**	**700**

# indicates work load of Learner (Not Faculty), for Major Project

Sem. VII: Department Optional Course – 3

BMDO7011: Biological Modeling and Simulation
BMDO7012: Bioinformatics
BMDO7013: IoT based Systems

Sem. VII: Department Optional Course – 4

BMDO7021: Rehabilitation Engineering
BMDO7022: Lasers and Fibre Optics
BMDO7023: Networking and Information Systems in Medicine

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. /Tut.	Theory	Pract.	Total
BMC801	Hospital Management	3	--	3	--	3
BMDO801X	Department Optional Course – 5	3	--	3	--	3
BMDO802X	Department Optional Course – 6	3	--	3	--	3
BMIO801	Institute Optional Course - 2	3	--	3	--	3
BML801	Hospital Management Lab	--	2	--	1	1
BML802	Department Optional Course – 5 Lab	--	2	--	1	1
BMP801	Major Project - II	--	12#	--	6	6
Total		**12**	**16**	**12**	**8**	**20**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC801	Hospital Management	20	20	20	80	3	--	--	100
BMDO801X	Department Optional Course – 5	20	20	20	80	3	--	--	100
BMDO802X	Department Optional Course – 6	20	20	20	80	3	--	--	100
BMIO801	Institute Optional Course - 2	20	20	20	80	3	--	--	100
BML801	Hospital Management Lab	--	--	--	--	--	25	25	50
BML802	Department Optional Course – 5 Lab	--	--	--	--	--	25	25	50
BMP801	Major Project - II	--	--	--	--	--	100	50	150
Total		**--**	**--**	**80**	**320**	**--**	**150**	**100**	**650**

# indicates work load of Learner (Not Faculty), for Major Project

Sem. VIII: Department Optional Course – 5

BMDO8011: Robotics in Medicine
BMDO8012: Healthcare Informatics
BMDO8013: Artificial Intelligence in Medicine

Sem. VIII: Department Optional Course – 6

BMDO8021: Biomedical Microsystems
BMDO8022: Medical Device Regulations
BMDO8023: Ergonomics

Students group and load of faculty per week.

Mini Project 1 and 2 :
Students can form groups with minimum 2 (Two) and not more than 4 (Four)
Faculty Load : 1 hour per week per four groups

Major Project 1 and 2 :
Students can form groups with minimum 2 (Two) and not more than 4 (Four)
Faculty Load : In Semester VII – ½ hour per week per project group
In Semester VIII – 1 hour per week per project group