

**UNIVERSITY OF MUMBAI**



**Bachelor of Engineering**

**Computer Engineering**  
( Sem. V to VIII)

Revised course

(REV- 2012) from Academic Year 2014-15,

Under

**FACULTY OF TECHNOLOGY**

(As per Semester Based Credit and Grading System)

## **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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**

**Dean,**

**Faculty of Technology,**

**Member - Management Council, Senate, Academic Council**

**University of Mumbai, Mumbai**

## **Preamble:**

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

The Program Educational Objectives finalized for undergraduate program in Computer Engineering are listed below:

1. To prepare Learner's with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To prepare Learner's to use effectively modern tools to solve real life problems
3. To equip Learner's with broad education necessary to understand the impact of computer Technology in a global and social context
4. To encourage , motivate and prepare Learner's for Lifelong-learning
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities

In addition to above 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

The Program outcomes are the skills and ability that Learner will demonstrate upon completion of undergraduate degree program in Computer Engineering. Few may be listed as follows:

1. Ability to effectively apply knowledge of computing and mathematics to computer science problems.
2. Ability to design, implement and evaluate computer-based components, systems, processes or programs to meet desired needs and specifications.
3. Ability and skills to effectively use state-of-the-art techniques and computing tools for analysis, design, and implementation of computing systems.
4. Ability to function effectively as a member of a team assembled to undertake a common goal.
5. An understanding of professional, ethical, legal, security, and social issues and responsibilities.

6. Ability to communicate effectively to both technical and non-technical audiences.
7. The ability to successfully pursue professional development thru lifelong learning

In addition to Program Educational Objectives, for each course of undergraduate program, Course Objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. Prachi Gharpure

Chairperson, Adhoc Board of Studies in Computer Engineering,

University of Mumbai, Mumbai

**Program Structure B.E. Computer Engineering**  
**Fourth Year (Computer) (Semester VII)**  
 (REV 2012)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CPC701	Digital Signal Processing	4	2	-	4	1	-	5
CPC702	Cryptography and System Security	4	2	-	4	1	-	5
CPC703	Artificial Intelligence	4	2	-	4	1	-	5
CPE7042X	Elective-II	4	2	-	4	1	-	5
CPP701	Project I	-	6#	-	-	3	-	3
CPL701	Network Threats and Attacks Laboratory	-	4	-	-	2	-	2
<b>Total</b>		<b>16</b>	<b>18</b>	<b>-</b>	<b>16</b>	<b>9</b>	<b>-</b>	<b>25</b>

Course Code	Course Name	Examination Scheme									
		Internal Assessment					End Sem Exam	Exam Duration (in Hrs)	TW	oral	Total
		Internal Assessment			Avg						
		Test 1	Test 2	Avg							
CPC701	Digital Signal Processing	20	20	20	80	03	25	-	125		
CPC702	Cryptography and System Security	20	20	20	80	03	25	25	150		
CPC703	Artificial Intelligence	20	20	20	80	03	25	25	150		
CPE7042X	Elective-II	20	20	20	80	03	25	25	150		
CPP701	Project I	-	-	-	-	-	50	50	100		
CPL701	Network Threats and Attacks Laboratory	-	-	-	-	-	25	50	75		
<b>Total</b>		<b>-</b>	<b>-</b>	<b>80</b>	<b>320</b>	<b>-</b>	<b>175</b>	<b>175</b>	<b>750</b>		

**Program Structure for B.E. Computer Engineering  
Second Year (Computer) ( Semester VIII)**

(REV 2012)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tu t	Theory	TW/ Pract	Tut	Total
CPC801	Data Warehouse and Mining	4	2	-	4	1	-	5
CPC802	Human Machine Interaction	4	2	-	4	1	-	5
CPC803	Parallel and distributed Systems	4	2	-	4	1	-	5
CPE803X	Elective-III	4	2	-	4	1	-	5
CPP802	Project II	-	12 #	-	-	6	-	6
CPL801	Cloud Computing Laboratory	-	2	-	-	1	-	1
<b>Total</b>		<b>16</b>	<b>22</b>	<b>-</b>	<b>16</b>	<b>11</b>	<b>-</b>	<b>27</b>

Course Code	Course Name	Examination Scheme									
		Internal Assesment					End Sem Exam	Exam Duration ( in Hrs)	TW	oral	Tot
		Internal Assesment			Test 1	Test 2					
		Test 1	Test 2	Avg							
CPC801	Data Warehouse and Mining	20	20	20	80	03	25	25	150		
CPC802	Human Machine Interaction	20	20	20	80	03	25	25	150		
CPC803	Parallel and distributed Systems	20	20	20	80	03	25	25	150		
CPE803X	Elective-III	20	20	20	80	03	25	25	150		
CPP802	Project II	-	-	-	-	-	50	50	100		
CPL801	Cloud Computing Laboratory	-	-	-	-	-	25	-	25		
<b>Total</b>				80	320		175	150	725		

# Indicate workload for Learner and not for Faculty in semester VII and VIII

AC – 11.05.2017

Item No. 4.193

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

## FACULTY OF TECHNOLOGY

### **Computer Engineering**

**Second Year** with Effect from **AY 2017-18**

**Third Year** with Effect from **AY 2018-19**

**Final Year** with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

**Co-ordinator, Faculty of Technology's 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**  
**Co-ordinator,**  
**Faculty of Technology,**  
**Member - Academic Council**  
**University of Mumbai, Mumbai**



**Chairman's Preamble:**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the 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 Computer Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brainstorming session, which was attended by more than 85 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Computer Engineering. The Program Educational Objectives finalized for the undergraduate program in Computer Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems.
3. To equip the Learner with broad education necessary to understand the impact of Computer Science and Engineering in a global and social context.
4. To encourage, motivate and prepare the Learner's for Lifelong- learning.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Dr. Subhash K. Shinde**

**Chairman, Board of Studies in Computer Engineering,  
University of Mumbai, Mumbai.**

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2017-18**

**S. E. Computer Engineering (Semester-III)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC301	Applied Mathematics -III	4+1@	-	-	5	-	-	5
CSC302	Digital Logic Design and Analysis	4	-	-	4	-	-	4
CSC303	Discrete Mathematics	3+1@	-	-	4	-	-	4
CSC304	Electronic Circuits and Communication Fundamentals	4	-	-	4	-	-	4
CSC305	Data Structures	4	-	-	4	-	-	4
CSL301	Digital System Lab	-	2	-	-	1	-	1
CSL302	Basic Electronics Lab	-	2	-	-	1	-	1
CSL303	Data structure Lab	-	2	-	-	1	-	1
CSL304	OOPM(Java) Lab	-	2+2*	-	-	2	-	2
<b>Total</b>		<b>21</b>	<b>10</b>	<b>-</b>	<b>21</b>	<b>5</b>	<b>-</b>	<b>26</b>

@ 1 hour to be taken tutorial as class wise.

\*2 hours shown as practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
Test 1	Test 2	Avg.								
CSC301	Applied Mathematics -III	20	20	20	80	3	-	-	-	100
CSC302	Digital Logic Design and Analysis	20	20	20	80	3	-	-	-	100
CSC303	Discrete Structures	20	20	20	80	3	-	-	-	100
CSC304	Electronic Circuits and Communication Fundamentals	20	20	20	80	3	-	-	-	100
CSC305	Data Structures	20	20	20	80	3	--	-	-	100
CSL301	Digital System Lab	-	-	-	-	-	25	--	25	50
CSL302	Basic Electronics Lab	-	-	-	-	-	25	25	---	50
CSL303	Data structure Lab	-	-	-	-	-	25	-	25	50
CSL304	OOPM(Java) Lab	-	-	-	-	-	50	--	50	100
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>125</b>	<b>25</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2017-18**

**S. E. Computer Engineering (Semester-IV)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC401	Applied Mathematics- IV	4+1@	-	-	5	-	-	5
CSC402	Analysis of Algorithms	4	-	-	4	-	-	4
CSC403	Computer Organization and Architecture	4	-	-	4	-	-	4
CSC404	Computer Graphics	4	-	-	4	-	-	4
CSC405	Operating System	4	-	-	4	-	-	4
CSL401	Analysis of Algorithms Lab	-	2	-	-	1	-	1
CSL402	Computer Graphics Lab	-	2	-	-	1	-	1
CSL403	Processor Architecture Lab	-	2	-	-	1	-	1
CSL404	Operating System Lab	-	2	-	-	1	-	1
CSL405	Open Source Tech Lab	-	2+2*	-	-	2	-	2
<b>Total</b>		<b>21</b>	<b>12</b>	<b>-</b>	<b>21</b>	<b>6</b>	<b>-</b>	<b>27</b>

@ 1 hour to be taken tutorial as class wise .

\*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration ( in Hrs)				
		Test 1	Test 2	Avg.						
CSC401	Applied Mathematics- IV	20	20	20	80	3	-	-	-	100
CSC402	Analysis of Algorithms	20	20	20	80	3	-	-	-	100
CSC403	Computer Organization and Architecture	20	20	20	80	3	-	-	-	100
CSC404	Computer Graphics	20	20	20	80	3	-	-	-	100
CSC405	Operating System	20	20	20	80	3	--	-	-	100
CSL401	Analysis of Algorithms Lab	-	-	-	-	-	25	--	25	50
CSL402	Computer Graphics Lab	-	-	-	-	-	25	--	25	50
CSL403	Processor Architecture Lab	-	-	-	-	-	25	25	-	50
CSL404	Operating System Lab	-	-	-	-	-	25	-	25	50
CSL405	Open Source Tech Lab	-	-	-	-	-	25	---	25	50
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>125</b>	<b>25</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19**

**T. E. Computer Engineering (Semester-V)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC501	Microprocessor	4	-	-	4	-	-	4
CSC502	Database Management System	4	-	-	4	-	-	4
CSC503	Computer Network	4	-	-	4	-	-	4
CSC504	Theory of Computer Science	3+1@	-	-	4	-	-	4
CSDL0501X	Department Level Optional Course -I	4	-	-	4	-	-	4
CSL501	Microprocessor Lab	-	2	-	-	1	-	1
CSL502	Computer Network Lab	-	2	-	-	1	-	1
CSL503	Database & Info. System Lab	-	2	-	-	1	-	1
CSL504	Web Design Lab	-	2+2*	-	-	2	-	2
CSL505	Business Comm. & Ethics	-	2+2*	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>14</b>	<b>-</b>	<b>20</b>	<b>7</b>	<b>-</b>	<b>27</b>

@ 1 hour to be taken tutorial as class wise.

\*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme							Total
		Theory					TW	Oral & Pract	
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
CSC501	Microprocessor	20	20	20	80	3	-	-	100
CSC502	Database Management System	20	20	20	80	3	-	-	100
CSC503	Computer Network	20	20	20	80	3	-	-	100
CSC504	Theory of Computer Science	20	20	20	80	3	-	-	100
CSDL0501X	Department Level Optional Course -I	20	20	20	80	3	--	-	100
CSL501	Microprocessor Lab	-	-	-	-	-	25	25	50
CSL502	Computer Network Lab	-	-	-	-	-	25	25	50
CSL503	Database & Info. System Lab	-	-	-	-	-	25	25	50
CSL504	Web Design Lab	-	-	-	-	-	25	25	50
CSL505	Business Comm. & Ethics	-	-	-	-	-	50	-	50
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>150</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19**

**T. E. Computer Engineering (Semester-VI)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC601	Software Engineering	4	-	-	4	-	-	4
CSC602	System Programming & Compiler Construction	4	-	-	4	-	-	4
CSC603	Data Warehousing & Mining	4	-	-	4	-	-	4
CSC604	Cryptography & System Security	4	-	-	4	-	-	4
CSDL0601X	Department Level Optional Course -II	4	-	-	4	-	-	4
CSL601	Software Engineering Lab	-	2	-	-	1	-	1
CSL602	System software Lab	-	2	-	-	1	-	1
CSL603	Data Warehousing & Mining Lab	-	2	-	-	1	-	1
CSL604	System Security Lab	-	2	-	-	1	-	1
CSP605	Mini-Project	-	4	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>12</b>	<b>-</b>	<b>20</b>	<b>6</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC601	Software Engineering	20	20	20	80	3	-	-	-	100
CSC602	System Programming & Compiler Construction	20	20	20	80	3	-	-	-	100
CSC603	Data Warehousing & Mining	20	20	20	80	3	-	-	-	100
CSC604	Cryptography & System Security	20	20	20	80	3	-	-	-	100
CSDL0601X	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
CSL601	Software Engineering Lab	-	-	-	-	-	25	25	--	50
CSL602	System Software Lab	-	-	-	-	-	25	--	25	50
CSL603	Data Warehousing & Mining Lab	-	-	-	-	-	25	--	25	50
CSL604	System Security Lab	-	-	-	-	-	25	---	25	50
CSP605	Mini-Project	-	-	-	-	-	25	---	25	50
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>150</b>	<b>25</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20**  
**B. E. Computer Engineering (Semester-VII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC701	Digital Signal & Image Processing	4	-	-	4	-	-	4
CSC702	Mobile Communication & Computing	4	-	-	4	-	-	4
CSC703	Artificial Intelligence & Soft Computing	4	-	-	4	-	-	4
CSDLO 701X	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course-I	3	-	-	3	-	-	3
CSL701	Digital Signal & Image Processing Lab	-	2	-	-	1	-	1
CSL702	Mobile App. Development. Tech. Lab	-	2	-	-	1	-	1
CSL703	Artificial Intelligence & Soft Computing Lab	-	2	-	-	1	-	1
CSL704	Computational Lab-I	-	2	-	-	1	-	1
CSP705	Major Project-I	-	6	-	-	3	-	3
	<b>Total</b>	<b>19</b>	<b>14</b>	<b>-</b>	<b>19</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC701	Digital Signal & Image Processing	20	20	20	80	3	-	--	-	100
CSC702	Mobile Communication & Computing	20	20	20	80	3	-	--	-	100
CSC703	Artificial Intelligence & Soft Computing	20	20	20	80	3	-	--	-	100
CSDLO 701X	Department Level Optional Course -III	20	20	20	80	3	-	--	-	100
ILO701X	Institute Level Optional Course-I	20	20	20	80	3	--	--	-	100
CSL701	Digital Signal & Image Processing Lab	-	-	-	-	-	25	--	--	25
CSL702	Mobile App. Development. Tech. Lab	-	-	-	-	-	25	--	25	50
CSL703	Artificial Intelligence & Soft Computing Lab	--	-	-	-	--	25	25	--	50
CSL704	Computational Lab-I						25	--	25	50
CSP705	Major Project-I	-	-	-	-	-	50	-	25	75
	<b>Total</b>	100	100	100	400		150	25	75	750

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20**

**B. E. Computer Engineering (Semester-VIII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC801	Human Machine Interaction	4	-	-	4	-	-	4
CSC802	Distributed Computing	4	-	-	4	-	-	4
CSDLO 801X	Department Level Optional Course -IV	4	-	-	4	-	-	4
ILO801X	Institute Level Optional Course-II	3	-	-	3	-	-	3
CSL801	Human Machine Interaction Lab	-	2	-	-	1	-	1
CSL802	Distributed Computing Lab	-	2	-	-	1	-	1
CSL803	Cloud Computing Lab	-	4	-	-	2	-	2
CSL804	Computational Lab-II	-	2	-	-	1	-	1
CSP805	Major Project-II	-	12	-	-	6	-	6
	<b>Total</b>	<b>15</b>	<b>22</b>	<b>-</b>	<b>15</b>	<b>11</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration ( in				
		Test 1	Test 2	Avg.						
CSC801	Human Machine Interaction	20	20	20	80	3	-	-	-	100
CSC802	Distributed Computing	20	20	20	80	3	-	-	-	100
CSDLO 801X	Department Level Optional Course -IV	20	20	20	80	3	-	-	-	100
ILO801X	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
CSC801	Human Machine Interaction Lab						25	25	-	50
CSL802	Distributed Computing Lab	-	-	-	-	-	25	25	-	50
CSL803	Cloud Computing Lab	-	-	-	-	-	50	--	25	75
CSL804	Computational Lab-II	-	-	-	-	-	50	--	25	75
CSP805	Major Project-II						50		50	100
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>		<b>100</b>	<b>750</b>

Sem.	Department Level Optional Course (DLOC)	Institute Level Optional Course (ILOC)
V	CSDL05011: Multimedia System CSDL05012: Advance Operating System CSDL05013: Advance Algorithm	-----
VI	CSDL06021: Machine Learning CSDL06022: Advance Database System CSDL06023: Enterprise Resource Planning CSDL06024: Advance Computer Network	-----
VII	CSDL07031: Advance System Security & Digital Forensics CSDL07032: Big Data & Analytics CSDL07033: Robotics	ILO7011. Product Lifecycle Management ILO7012. Reliability Engineering ILO7013. Management Information System ILO7014. Design of Experiments ILO7015. Operation Research ILO7016. Cyber Security and Laws ILO7017. Disaster Management & Mitigation Measures ILO7018. Energy Audit and Management ILO7019. Development Engineering
VIII	DLO8011: High Performance Computing DLO8012: Natural Language Processing DLO8013: Adhoc Wireless Network	ILO8021. Project Management ILO8022. Finance Management ILO8023. Entrepreneurship Development and Management ILO8024. Human Resource Management ILO8025. Professional Ethics and CSR ILO8026. Research Methodology ILO8027. IPR and Patenting ILO8028. Digital Business Management ILO8029. Environmental Management



# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Computer 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)

**UNIVERSITY OF MUMBAI****Syllabus for Approval**

Date

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year B.E. Computer Engineering</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./Diploma /Certificate</b> (Strike out which is not applicable)
7	Pattern	<b>Yearly / Semester</b> (Strike out which is not applicable )
8	Status	<b>New / Revised</b> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2020-2021</b>

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 13 weeks and remaining 2 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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## **Preface by Board of Studies in Computer Engineering**

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Second Year Computer Engineering syllabus effective from the Academic Year 2020-21 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting and challenging.

Computer Engineering is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability.
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

### **Board of Studies in Computer Engineering**

Prof. Sunil Bhirud : Chairman

Prof. Madhumita Chatterjee : Member

Prof. Sunita Patil : Member

Prof. Leena Raga : Member

Prof. Subhash Shinde : Member

Prof. Meera Narvekar : Member

Prof. Suprtim Biswas : Member

Prof. Sudhir Sawarkar : Member

Prof. Dayanand Ingle : Member

Prof. Satish Ket : Member

## Program Structure for Second Year Computer Engineering

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	
CSC301	Engineering Mathematics-III	3	--	1*	3	--	1	4	
CSC302	Discrete Structures and Graph Theory	3	--	--	3	--	--	3	
CSC303	Data Structure	3	--	--	3	--	--	3	
CSC304	Digital Logic & Computer Architecture	3	--	--	3	--	--	3	
CSC305	Computer Graphics	3	--	--	3	--	--	3	
CSL301	Data Structure Lab	--	2	--	--	1	--	1	
CSL302	Digital Logic & Computer Architecture Lab	--	2	--	--	1	--	1	
CSL303	Computer Graphics Lab	--	2	--	--	1	--	1	
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	2+2*	--	--	2	--	2	
CSM301	Mini Project – 1 A	--	4 <sup>\$</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>07</b>	<b>1</b>	<b>23</b>	
<b>Course Code</b>	<b>Course Name</b>	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Pract &amp; oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem. Exam</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test 1</b>	<b>Test2</b>	<b>Avg</b>					
CSC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
CSC302	Discrete Structures and Graph Theory	20	20	20	80	3	--	--	100
CSC303	Data Structure	20	20	20	80	3	--	--	100
CSC304	Digital Logic & Computer Architecture	20	20	20	80	3	--	--	100
CSC305	Computer Graphics	20	20	20	80	3	--	--	100
CSL301	Data Structure Lab	--	--	--	--	--	25	25	50
CSL302	Digital Logic & Computer Architecture Lab	--	--	--	--	--	25	--	25
CSL303	Computer Graphics Lab	--	--	--	--	--	25	25	50
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	--	--	--	--	50	25	75
CSM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

\*Should be conducted batch wise and

\$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

**Program Structure for Second Year Computer Engineering**

**UNIVERSITY OF MUMBAI (With Effect from 2020-2021)**

**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CSC401	Engineering Mathematics-IV	3	--	1*	3	--	1	4	
CSC402	Analysis of Algorithm	3	--	--	3	--	--	3	
CSC403	Database Management System	3	--	--	3	--	--	3	
CSC404	Operating System	3	--	--	3	--	--	3	
CSC405	Microprocessor	3	--	--	3	--	--	3	
CSL401	Analysis of Algorithm Lab	--	2	--	--	1	--	1	
CSL402	Database Management System Lab	--	2	--	--	1	--	1	
CSL403	Operating System Lab	--	2	--	--	1	--	1	
CSL404	Microprocessor Lab	--	2	--	--	1	--	1	
CSL405	Skill Base Lab Course: Python Programming	--	2*+2	--	--	2	--	2	
CSM401	Mini Project 1-B	--	4 <sup>§</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>16</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>24</b>	
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Pract &amp; oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem. Exam.</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test 1</b>	<b>Test 2</b>	<b>Avg.</b>					
CSC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
CSC402	Analysis of Algorithm	20	20	20	80	3	--	--	100
CSC403	Database Management System	20	20	20	80	3	--	--	100
CSC404	Operating System	20	20	20	80	3	--	--	100
CSC405	Microprocessor	20	20	20	80	3	--	--	100
CSL401	Analysis of Algorithm Lab	--	--	--	--	--	25	25	50
CSL402	Database Management System Lab	--	--	--	--	--	25	25	50
CSL403	Operating System Lab	--	--	--	--	--	25	25	50
CSL404	Microprocessor Lab	--	--	--	--	--	25	--	25
CSL405	Skill Base Lab Course: Python Programming	--	--	--	--	--	25	--	25
CSM401	Mini Project 1-B	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

\*Should be conducted batchwise and

§ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups.

AC: 29/06/2021

Item No: 6.15

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Computer 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)



AC: 29/06/2021

Item No: 6.15

## **UNIVERSITY OF MUMBAI**



<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
1	Title of the Course	<b>Third Year Engineering ( Computer Engineering)</b>
2	Eligibility for Admission	<b>After Passing Second Year Engineering as per the Ordinance 0.6243</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6243</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./<del>Diploma</del> / Certificate</b> (Strike out which is not applicable)
7	Pattern	<b><del>Yearly</del> / Semester</b> (Strike out which is not applicable )
8	Status	<b>New / Revised</b> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2021-2022</b>

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
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## 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 13 weeks and remaining 2 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 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

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Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
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University of Mumbai

## **ncorporation 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.

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University of Mumbai

Dr Anuradha Muzumdar  
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University of Mumbai

# **Preface by Board of Studies in Computer Engineering**

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Third Year Computer Engineering syllabus effective from the Academic Year 2021-22 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting, challenging, fulfill certain needs and expectations.

Computer Engineering is one of the most sought-after courses amongst engineering students. The syllabus needs revision in terms of preparing the student for the professional scenario relevant and suitable to cater the needs of industry in present day context. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus is finalized through a brain storming session attended by Heads of Departments or senior faculty from the Department of Computer Engineering of the affiliated Institutes of the Mumbai University. The syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. The department Optional Courses will provide the relevant specialization within the branch to a student.
3. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability.
4. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

## **Board of Studies in Computer Engineering**

Prof. Sunil Bhirud	: Chairman
Prof. Sunita Patil	: Member
Prof. Leena Raga	: Member
Prof. Subhash Shinde	: Member
Prof. Meera Narvekar	: Member
Prof. Suprtim Biswas	: Member
Prof. Sudhir Sawarkar	: Member
Prof. Dayanand Ingle	: Member
Prof. Satish Ket	: Member

**Program Structure for Third Year Computer Engineering**  
**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			
CSC501	Theoretical Computer Science	3	--	3	--	3			
CSC502	Software Engineering	3	--	3		3			
CSC503	Computer Network	3	--	3	--	3			
CSC504	Data Warehousing & Mining	3	--	3	--	3			
CSDLO501x	Department Level Optional Course- 1	3	--	3	--	3			
CSL501	Software Engineering Lab	--	2	--	1	1			
CSL502	Computer Network Lab	--	2	--	1	1			
CSL503	Data Warehousing & Mining Lab	--	2	--	1	1			
CSL504	Professional Comm. & Ethics II	--	2*+2	--	2	2			
CSM501	Mini Project: 2 A	--	4 <sup>s</sup>	--	2	2			
<b>Total</b>		<b>15</b>	<b>14</b>	<b>15</b>	<b>07</b>	<b>22</b>			
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Pract &amp; oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem Exam</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test 1</b>	<b>Test 2</b>	<b>Avg</b>					
CSC501	Theoretical Computer Science	20	20	20	80	3	25	--	125
CSC502	Software Engineering	20	20	20	80	3	--	--	100
CSC503	Computer Network	20	20	20	80	3	--	--	100
CSC504	Data Warehousing & Mining	20	20	20	80	3	--	--	100
CSDLO501x	Department Level Optional Course -1	20	20	20	80	3	--	--	100
CSL501	Software Engineering Lab	--	--	--	--	--	25	25	50
CSL502	Computer Network Lab	--	--	--	--	--	25	25	50
CSL503	Data Warehousing & Mining Lab	--	--	--	--	--	25	25	50
CSL504	Professional Comm. & Ethics II	--	--	--	--	--	50	--	50
CSM501	Mini Project : 2A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

\* Theory class to be conducted for full class and \$ indicates workload of Learner (Not Faculty), students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

**Program Structure for Third Year Computer Engineering  
UNIVERSITY OF MUMBAI (With Effect from 2021-2022)**

**Semester VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract. Tut.	Theory	Pract.	Total			
CSC601	System Programming & Compiler Construction	3	--	3	--	3			
CSC602	Cryptography & System Security	3	--	3	--	3			
CSC603	Mobile Computing	3	--	3	--	3			
CSC604	Artificial Intelligence	3	--	3	--	3			
CSDLO601x	Department Level Optional Course -2	3	--	3	--	3			
CSL601	System Programming & Compiler Construction Lab	--	2	--	1	1			
CSL602	Cryptography & System Security Lab	--	2	--	1	1			
CSL603	Mobile Computing Lab	--	2	--	1	1			
CSL604	Artificial Intelligence Lab	--	2	--	1	1			
CSL605	Skill base Lab Course: Cloud Computing	--	4	--	2	2			
CSM601	Mini Project Lab: 2B	--	4 <sup>s</sup>	--	2	2			
<b>Total</b>		<b>15</b>	<b>16</b>	<b>15</b>	<b>08</b>	<b>23</b>			
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					
CSC601	System Programming & Compiler Construction	20	20	20	80	3	--	--	100
CSC602	Cryptography & System Security	20	20	20	80	3	--	--	100
CSC603	Mobile Computing	20	20	20	80	3	--	--	100
CSC604	Artificial Intelligence	20	20	20	80	3	--	--	100
CSDLO601x	Department Level Optional Course -2	20	20	20	80	3	--	--	100
CSL601	System Programming & Compiler Construction Lab	--	--	--	--	--	25	25	50
CSL602	Cryptography & System Security Lab	--	--	--	--	--	25	--	25
CSL603	Mobile Computing Lab	--	--	--	--	--	25	-	25
CSL604	Artificial Intelligence Lab	--	--	--	--	--	25	25	50
CSL605	Skill base Lab Course: Cloud Computing	--	--	--	--	--	50	25	75
CSM601	Mini Project :2B	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

**Program Structure for Computer Engineering**  
**UNIVERSITY OF MUMBAI (With Effect from 2021-2022)**

**Department Optional Courses**

<b>Department Level Optional Courses</b>	<b>Semester</b>	<b>Code &amp; Course</b>
Department Level Optional Course -1	V	CSDLO5011: Probabilistic Graphical Models CSDLO5012: Internet Programming CSDLO5013: Advance Database Management System
Department Level Optional Course -2	VI	CSDLO6011: Internet of Things CSDLO6012: Digital Signal & Image Processing CSDLO6013: Quantitative Analysis

# **UNIVERSITY OF MUMBAI**



## **Bachelor of Engineering**

**Information Technology (Second Year – Sem. III & IV)**

**Revised course (REV- 2012)**

**From Academic Year 2013 -14**

**Under**

## **FACULTY OF TECHNOLOGY**

**(As per Semester Based Credit and Grading System)**



## **From Dean's Desk:**

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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**  
**Dean,**  
**Faculty of Technology,**  
**Member - Management Council, Senate, Academic Council**  
**University of Mumbai, Mumbai**

## **Preamble**

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Information Technology of University of Mumbai, happy to state here that, Program Educational Objectives were finalized in a meeting where more than 30 members from different Institutes were attended, who were either Heads or their representatives of Information Technology Department. The Program Educational Objectives finalized for undergraduate program in Information Technology are listed below;

1. To prepare Learner's with a sound foundation in the basics of engineering fundamentals.
2. To prepare Learner's to use effectively modern programming tools to solve real life problems.
3. To prepare Learner's for successful career in Indian and Multinational Organisations and to excel in Postgraduate studies
4. To encourage and motivate Learner's for entrepreneurship.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in Learners.
6. To encourage Learner to use best practices and implement technologies to enhance information security and enable compliance, ensuring confidentiality, information integrity, and availability.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

**Dr. J. W. Bakal**  
**Chairman, Board of Studies in Information Technology,**  
**University of Mumbai, Mumbai**

**B.E. Engineering (Semester VII)**  
**Revised course for Information Technology**  
**Academic Year 2015 -16 (REV- 2012)**

Course Code	Course Name	Teaching Scheme (hrs/week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Prac	Tut.	Total
BEITC701	Software Project Management	4			4			4
BEITC702	Cloud Computing	3			3			3
BEITC703	Intelligent System	4			4			4
BEITC704	Wireless Technology	4			4			4
BEITC705	Elective - I	4			4			4
BEITL701	Software Project Management		2			1		1
BEITL702	Cloud Computing		2			1		1
BEITL703	Intelligent System		2			1		1
BEITL704	Wireless Technology		2			1		1
BEITT705	Elective - I		2			1		1
BEITP706	Project-I		*			3		3
	Total	19	10		19	08		27

**\*Work load of the teacher in semester VII is equivalent to 6 hrs/week.**

<b>Elective –I ( Semester VII)</b>	
BEITC7051	Image Processing
BEITC7052	Software Architecture
BEITC7053	E-Commerce & E-Business
BEITC7054	Multimedia Systems
BEITC7055	Usability Engineering
BEITC7056	Ubiquitous Computing

**B.E. Engineering (Semester VIII)**  
**Revised course for Information Technology from**  
**Academic Year 2015 -16, (REV- 2012)**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
BEITC801	Storage Network Management and Retrieval	4			4			4
BEITC802	Big Data Analytics	4			4			4
BEITC803	Computer Simulation and Modeling	4			4			4
BEITC804	Elective -II	4			4			4
BEITL801	Storage Network Management and Retrieval		2			1		1
BEITL802	Big Data Analytics		2			1		1
BEITL803	Computer Simulation and Modeling		2			1		1
BEITL804	Elective -II		2			1		1
BEITP805	Project - II		**			6		6
	Total	16	08		16	10		26

**\*\*Workload of the teacher in semester VIII is equivalent to 12 hrs/week.**

<b>Elective –I I ( Semester VIII)</b>	
BEITC8041	Enterprise Resource Planning
BEITC8042	Wireless Sensor Networks
BEITC8043	Geographical Information Systems
BEITC8044	Robotics
BEITC8045	Soft Computing
BEITC8046	Software Testing & Quality Assurance

**B.E. Engineering (Semester VIII)**  
**Revised course for Information Technology from**  
**Academic Year 2015 -16, (REV- 2012)**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
BEITC801	Storage Network Management and Retrieval	4			4			4
BEITC802	Big Data Analytics	4			4			4
BEITC803	Computer Simulation and Modeling	4			4			4
BEITC804	Elective -II	4			4			4
BEITL801	Storage Network Management and Retrieval		2			1		1
BEITL802	Big Data Analytics		2			1		1
BEITL803	Computer Simulation and Modeling		2			1		1
BEITL804	Elective -II		2			1		1
BEITP805	Project - II		**			6		6
	Total	16	08		16	10		26

**\*\*Workload of the teacher in semester VIII is equivalent to 12 hrs/week.**

<b>Elective –I I ( Semester VIII)</b>	
BEITC8041	Enterprise Resource Planning
BEITC8042	Wireless Sensor Networks
BEITC8043	Geographical Information Systems
BEITC8044	Robotics
BEITC8045	Soft Computing
BEITC8046	Software Testing & Quality Assurance

## Examination Scheme

Course Code	Course Name	Theory					Term work	Pract/ Oral	Total
		Internal Assessment			End sem exam	Exam duration (in Hrs)			
		TEST 1	TEST 2	AVG .					
BEITC801	Storage Network Management and Retrieval	20	20	20	80	3	25	25	150
BEITC802	Big Data Analytics	20	20	20	80	3	25	25	150
BEITC803	Computer Simulation and Modeling	20	20	20	80	3	25	25	150
BEITC804	Elective -II	20	20	20	80	3	25	25	150
BEITP805	Project - II						50	50	100
	Total	80	80	80	320	12	150	150	700

**Third Year Engineering (Semester V)**  
**Revised course for Information Technology**  
**Academic Year 2014-15 (REV- 2012)**

Sub Code	Subject Name	Teaching Scheme (hrs/week)			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/ Practical	Tut.	Total
ITC501	Computer Graphics and Virtual Reality	4			4			4
ITC502	Operating Systems	4			4			4
ITC503	Microcontroller and Embedded Systems	4			4			4
ITC504	Advanced Database Management Systems	4			4			4
ITC505	Open Source Technologies	3			3			3
ITC506	Business Communication and Ethics*		2**+2			2		2
ITL501	Computer Graphics and Virtual Reality		2			1		1
ITL502	Operating Systems		2			1		1
ITL503	Microcontroller and Embedded Systems		2			1		1
ITL504	Advanced Database Management Systems		2			1		1
ITL505	Open Source Technologies		2			1		1
	Total	19	12		19	07		26

**\*Common for all programs.**

**\*\*Theory class to be conducted for entire class.**

**Note: During third year of engineering learners can be exposed to industrial environment by arranging an industrial visit.**

## Examination Scheme

Course Code	Course Name	Theory					Term work	Pract/ Oral	Total
		Internal Assessment			End sem exam	Exam duration (in Hrs)			
		TEST 1	TEST 2	AVG.					
ITC501	Computer Graphics and Virtual Reality	20	20	20	80	3	25	25	150
ITC502	Operating Systems	20	20	20	80	3	25	25	150
ITC503	Microcontroller and Embedded Systems	20	20	20	80	3	25	25	150
ITC504	Advanced Database Management Systems	20	20	20	80	3	25	25	150
ITC505	Open Source Technologies	20	20	20	80	3	25	25	150
ITC506	Business Communication and Ethics*	---	---	---	---	---	25	25	050
	Total	100	100	100	400	15	150	150	800



**Third Year Engineering (Semester VI)**  
**Revised course for Information Technology**  
**Academic Year 2014 -15 (REV- 2012)**

Subject Code	Subject Name	Teaching Scheme (hrs/week)			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/Pract.	Tut.	Total
ITC601	Software Engineering	4			4			4
ITC602	Distributed Systems	4			4			4
ITC603	System and Web Security	4			4			4
ITC604	Data Mining and Business Intelligence	4			4			4
ITC605	Advance Internet Technology	4			4			4
ITL601	Software Engineering		2			1		1
ITL602	Distributed Systems		2			1		1
ITL603	System and Web Security		2			1		1
ITL604	Data Mining and Business Intelligence		2			1		1
ITL605	Advance Internet Technology		2			1		1
	Total	20	10		20	05		25

## Examination Scheme

Course Code	Course Name	Theory					Term work	Practical /Oral	Total
		Internal Assessment			End Sem exam	Exam duration (in Hrs)			
		TEST 1	TEST 2	AVG.					
ITC601	Software Engineering	20	20	20	80	3	25	25	150
ITC602	Distributed Systems	20	20	20	80	3	25	25	150
ITC603	System & Web Security	20	20	20	80	3	25	25	150
ITC604	Data Mining & Business Intelligence	20	20	20	80	3	25	25	150
ITC605	Advance Internet Technology	20	20	20	80	3	25	25	150
	Total	100	100	100	400	15	125	125	750

**Third Year Engineering (Semester VI)**  
**Revised course for Information Technology**  
**Academic Year 2014 -15 (REV- 2012)**

Subject Code	Subject Name	Teaching Scheme (hrs/week)			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/Pract.	Tut.	Total
ITC601	Software Engineering	4			4			4
ITC602	Distributed Systems	4			4			4
ITC603	System and Web Security	4			4			4
ITC604	Data Mining and Business Intelligence	4			4			4
ITC605	Advance Internet Technology	4			4			4
ITL601	Software Engineering		2			1		1
ITL602	Distributed Systems		2			1		1
ITL603	System and Web Security		2			1		1
ITL604	Data Mining and Business Intelligence		2			1		1
ITL605	Advance Internet Technology		2			1		1
	Total	20	10		20	05		25

## Examination Scheme

Course Code	Course Name	Theory					Term work	Practical /Oral	Total
		Internal Assessment			End Sem exam	Exam duration (in Hrs)			
		TEST 1	TEST 2	AVG.					
ITC601	Software Engineering	20	20	20	80	3	25	25	150
ITC602	Distributed Systems	20	20	20	80	3	25	25	150
ITC603	System & Web Security	20	20	20	80	3	25	25	150
ITC604	Data Mining & Business Intelligence	20	20	20	80	3	25	25	150
ITC605	Advance Internet Technology	20	20	20	80	3	25	25	150
	Total	100	100	100	400	15	125	125	750

**Third Year Engineering (Semester VI)**  
**Revised course for Information Technology**  
**Academic Year 2014 -15 (REV- 2012)**

Subject Code	Subject Name	Teaching Scheme (hrs/week)			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/Pract.	Tut.	Total
ITC601	Software Engineering	4			4			4
ITC602	Distributed Systems	4			4			4
ITC603	System and Web Security	4			4			4
ITC604	Data Mining and Business Intelligence	4			4			4
ITC605	Advance Internet Technology	4			4			4
ITL601	Software Engineering		2			1		1
ITL602	Distributed Systems		2			1		1
ITL603	System and Web Security		2			1		1
ITL604	Data Mining and Business Intelligence		2			1		1
ITL605	Advance Internet Technology		2			1		1
	Total	20	10		20	05		25

## Examination Scheme

Course Code	Course Name	Theory					Term work	Practical /Oral	Total
		Internal Assessment			End Sem exam	Exam duration (in Hrs)			
		TEST 1	TEST 2	AVG.					
ITC601	Software Engineering	20	20	20	80	3	25	25	150
ITC602	Distributed Systems	20	20	20	80	3	25	25	150
ITC603	System & Web Security	20	20	20	80	3	25	25	150
ITC604	Data Mining & Business Intelligence	20	20	20	80	3	25	25	150
ITC605	Advance Internet Technology	20	20	20	80	3	25	25	150
	Total	100	100	100	400	15	125	125	750

## S. E. (Information Technology) Sem.-IV

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Th	Pract	Tut	Th.	Pract/	Tut	Total
SEITC401	Applied Mathematics-IV*	4		1	4		1	5
SEITC402	Computer Networks	4			4			5
SEITC403	Computer Organization and Architecture	3		1	3		1	4
SEITC404	Automata Theory	3		1	3		1	4
SEITC405	Web Programming	4			4			5
SEITC406	Information Theory and Coding	4		1	4		1	5
SEITL402	Computer Networks		2			1		
SEITL405	Web Programming		2			1		
	Total	22	4	4	22	2	4	28

## Examination Scheme

Course Code	Course Name	Theory					Term work	Pract/ Oral	Total
		Internal Assessment			END SEM EXAM	EXAM DURATION (in Hrs)			
		TEST1	TEST 2	AVG.					
SEITC401	Applied Mathematics-IV*	20	20	20	80	3	25	--	125
SEITC402	Computer Networks	20	20	20	80	3	25	25	150
SEITC403	Computer Organization and Architecture	20	20	20	80	3	25	25	150
SEITC404	Automata Theory	20	20	20	80	3	25	--	125
SEITC405	Web Programming	20	20	20	80	3	25	25	150
SEITC406	Information Theory and Coding	20	20	20	80	3	25	--	125
	Total	120	120	120	480		150	75	825

\* Common with Computer Engineering.

Tutorials will be conducted class wise and will be evaluated as term work.

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

**FACULTY OF TECHNOLOGY**

## **Information Technology**

**Second Year** with Effect from AY 2017-18

**Third Year** with Effect from AY 2018-19

**Final Year** with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17



**Co-ordinator, Faculty of Technology's 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

## **Preamble**

It is an honor and a privilege to present the revised syllabus of Bachelor of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.

Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.

Industries views are that, only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain.

The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.

I sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

### **Program Outcome for graduate Program in Information Technology**

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

**Dr. Deven Shah**

**Chairman (Ad-hoc Board Information Technology)  
University of Mumbai)**

**University of Mumbai**

**Program Structure B.E. Information Technology, (Rev. 2016)**

**T. E. Information Technology (Semester-V)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC501	Microcontroller and Embedded Programming	4	-	-	4	-	-	4
ITC502	Internet Programming	4	-	-	4	-	-	4
ITC503	Advanced Data Management Technology	4	-	-	4	-	-	4
ITC504	Cryptography & Network Security	4	-	-	4	-	-	4
ITDLO-I	Department Level Optional Course-I	4	-	-	4	-	-	4
ITL501	Internet Programming Lab	-	2	-	-	1	-	1
ITL502	Security Lab	-	2	-	-	1	-	1
ITL503	OLAP Lab	-	2	-	-	1	-	1
ITL504	IOT (Mini Project) Lab	-	2	-	-	1	-	1
ITL505	Business Communication and Ethics	-	2+2*	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>14</b>	<b>-</b>	<b>20</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
Test 1	Test 2	Avg.								
ITC501	Microcontroller and Embedded Programming	20	20	20	80	3	-	-	100	
ITC502	Internet Programming	20	20	20	80	3	-	-	100	
ITC503	Advanced Data Management Technology	20	20	20	80	3	-	-	100	
ITC504	Cryptography & Network Security	20	20	20	80	3	-	-	100	
ITDLO-I	Department Level Optional Course-I	20	20	20	80	3	--	-	100	
ITL501	Internet Programming Lab	-	-	-	-	-	25	--	25	50
ITL502	Security Lab	-	-	-	-	-	25	25	--	50
ITL503	OLAP Lab	-	-	-	-	-	25	25	--	50

**T. E. Information Technology (Semester-VI)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC601	Software Engineering with Project Management	4	-	-	4	-	-	4
ITC602	Data Mining and Business Intelligence	4	-	-	4	-	-	4
ITC603	Cloud Computing & Services	4	-	-	4	-	-	4
ITC604	Wireless Networks	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -II	4	-	-	4	-	-	4
ITL601	Software Design Lab	-	2	-	-	1	-	1
ITL602	Business Intelligence Lab	-	2	-	-	1	-	1
ITL603	Cloud Service Design Lab	-	2	-	-	1	-	1
ITL604	Sensor Network Lab	-	2	-	-	1	-	1
ITM605	Mini-project	-	4	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>12</b>	<b>-</b>	<b>20</b>	<b>6</b>	<b>-</b>	<b>26</b>

**University of Mumbai**

**Program Structure B.E. Information Technology, (Rev. 2016)**

**B. E. Information Technology (Semester-VII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC701	Enterprise Network Design	4	-	-	4	-	-	4
ITC702	Infrastructure Security	4	-	-	4	-	-	4
ITC703	Artificial Intelligence	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO-I	Institute Level Optional Course-I	3	-	-	3	-	-	3
ITL701	Network Design Lab	-	2	-	-	1	-	1
ITL702	Advanced Security Lab	-	2	-	-	1	-	1
ITL703	Intelligence System Lab	-	2	-	-	1	-	1
ITL704	Android Apps Development Lab	-	2	-	-	1	-	1
ITM705	Project-I	-	6/8	-	-	3	-	3
	<b>Total</b>	<b>19</b>	<b>14</b>	<b>-</b>	<b>19</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC801	Big Data Analytics	4	-	-	4	-	-	4
ITC802	Internet of Everything	4	-	-	4	-	-	4
ITDLO-IV	Department Level Optional Course-IV	4	-	-	4	-	-	4
ILO-II	Institute Level Optional Course-II	3	-	-	3	-	-	3
ITL801	Big Data Lab	-	2	-	-	1	-	1
ITL802	Internet of Everything Lab	-	2	-	-	1	-	1
ITL803	DevOps Lab	-	2	-	-	1	-	1
ITL804	R Programming Lab	-	2	-	-	1	-	1
ITM805	Project-II	-	16	-	-	8	-	8
	<b>Total</b>	<b>15</b>	<b>24</b>	<b>-</b>	<b>15</b>	<b>12</b>	<b>-</b>	<b>27</b>

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Information Technology 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**

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## **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**

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# Preamble

It is our honor and a privilege to present the Rev-2019 'C' scheme syllabus of Bachelor of Engineering in Information Technology (effective from year 2019-20) with inclusion of cutting edge technology. Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement.

The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions. Industries views are considered as stakeholders will design of the syllabus of Information Technology. As per Industries views only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also first time we are giving skill-based labs and Mini-project to students from third semester onwards which will help students to work on latest IT technologies. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain. The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

We would like to thank senior faculties of IT department of all colleges affiliated to University of Mumbai for significant contribution in framing the syllabus. Also on behalf of all faculties we thank all the industry experts for their valuable feedback and suggestions. We sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

## **Program Specific Outcome for graduate Program in Information Technology**

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology and security domain.
3. Ability to work in multidisciplinary projects and make it IT enabled.
4. Ability to adapt latest trends and technologies like Analytics, Blockchain, Cloud, Data science.

### **BoS – IT Team**

**Dr. Deven Shah (BoS-Chairman)**

**Dr. Lata Ragma (BoS-Member)**

**Dr. Vaishali D. Khairnar (BoS-Member)**

**Dr. Sharvari Govilkar (BoS-Member)**

**Dr. Sunil B. Wankhade (BoS-Member)**

**Dr. Anil Kale (BoS-Member)**

**Dr. Vaibhav Narwade (BoS-Member)**

**Dr. GV Choudhary (BoS-Member)**

**Ad-hoc Board Information Technology**

**University of Mumbai**

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**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	
ITC301	Engineering Mathematics-III	3	--	1	3	--	1	4	
ITC302	Data Structure and Analysis	3		--	3		--	3	
ITC303	Database Management System	3	--	--	3	--	--	3	
ITC304	Principle of Communication	3	--	--	3	--	--	3	
ITC305	Paradigms and Computer Programming Fundamentals	3	--	--	3	--	--	3	
ITL301	Data Structure Lab	--	2	--	--	1	--	1	
ITL302	SQL Lab	--	2	--	--	1	--	1	
ITL303	Computer programming Paradigms Lab	--	2	--	--	1	--	1	
ITL304	Java Lab (SBL)	--	4	--	--	2	--	2	
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	4 <sup>\$</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>07</b>	<b>1</b>	<b>23</b>	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg.					
ITC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ITC302	Data Structure and Analysis	20	20	20	80	3	--	--	100
ITC303	Database Management System	20	20	20	80	3	--	--	100
ITC304	Principle of Communication	20	20	20	80	3	--	--	100
ITC305	Paradigms and Computer Programming Fundamentals	20	20	20	80	3	--	--	100
ITL301	Data Structure Lab	--	--	--	--	--	25	25	50
ITL302	SQL Lab	--	--	--	--	--	25	25	50
ITL303	Computer programming Paradigms Lab	--	--	--	--	--	25	25	50
ITL304	Java Lab (SBL)	--	--	--	--	--	25	25	50
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>	<b>125</b>	<b>775</b>

\$ indicates work load of Learner (Not Faculty), for Mini Project

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

**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
ITC401	Engineering Mathematics-IV	3	--	1	3	--	1	4	
ITC402	Computer Network and Network Design	3	--	--	3	--	--	3	
ITC403	Operating System	3	--	--	3	--	--	3	
ITC404	Automata Theory	3	--	--	3	--	--	3	
ITC405	Computer Organization and Architecture	3	--	--	3	--	--	3	
ITL401	Network Lab	--	2	--	--	1	--	1	
ITL402	Unix Lab	--	2	--	--	1	--	1	
ITL403	Microprocessor Lab	--	2	--	--	1	--	1	
ITL404	Python Lab (SBL)	--	4	--	--	2	--	2	
ITM401	Mini Project – 1 B for Python based automation projects	--	4 <sup>\$</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>23</b>	
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.					
ITC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
ITC402	Computer Network and Network Design	20	20	20	80	3	--	--	100
ITC403	Operating System	20	20	20	80	3	--	--	100
ITC404	Automata Theory	20	20	20	80	3	--	--	100
ITC405	Computer Organization and Architecture	20	20	20	80	3	--	--	100
ITL401	Network Lab	--	--	--	--	--	25	25	50
ITL402	Unix Lab	--	--	--	--	--	25	25	50
ITL403	Microprocessor Lab	--	--	--	--	--	25	25	50
ITL404	Python Lab (SBL)	--	--	--	--	--	25	25	50
ITM401	Mini Project – 1 B for Python based automation projects	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>	<b>75</b>	<b>775</b>

\$ indicates work load of Learner (Not Faculty), for Mini Project

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

**FACULTY OF TECHNOLOGY**

## **Information Technology**

**Second Year** with Effect from AY 2017-18

**Third Year** with Effect from AY 2018-19

**Final Year** with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**

with effect from the AY 2016-17

**Co-ordinator, Faculty of Technology's 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

## **Preamble**

It is an honor and a privilege to present the revised syllabus of Bachelor of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.

Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.

Industries views are that, only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain.

The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.

I sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

### **Program Outcome for graduate Program in Information Technology**

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

**Dr. Deven Shah**

**Chairman (Ad-hoc Board Information Technology)  
University of Mumbai)**

**University of Mumbai**

**Program Structure B.E. Information Technology, (Rev. 2016)**

**T. E. Information Technology (Semester-V)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC501	Microcontroller and Embedded Programming	4	-	-	4	-	-	4
ITC502	Internet Programming	4	-	-	4	-	-	4
ITC503	Advanced Data Management Technology	4	-	-	4	-	-	4
ITC504	Cryptography & Network Security	4	-	-	4	-	-	4
ITDLO-I	Department Level Optional Course-I	4	-	-	4	-	-	4
ITL501	Internet Programming Lab	-	2	-	-	1	-	1
ITL502	Security Lab	-	2	-	-	1	-	1
ITL503	OLAP Lab	-	2	-	-	1	-	1
ITL504	IOT (Mini Project) Lab	-	2	-	-	1	-	1
ITL505	Business Communication and Ethics	-	2+2*	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>14</b>	<b>-</b>	<b>20</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
Test 1	Test 2	Avg.								
ITC501	Microcontroller and Embedded Programming	20	20	20	80	3	-	-	100	
ITC502	Internet Programming	20	20	20	80	3	-	-	100	
ITC503	Advanced Data Management Technology	20	20	20	80	3	-	-	100	
ITC504	Cryptography & Network Security	20	20	20	80	3	-	-	100	
ITDLO-I	Department Level Optional Course-I	20	20	20	80	3	--	-	100	
ITL501	Internet Programming Lab	-	-	-	-	-	25	--	25	50
ITL502	Security Lab	-	-	-	-	-	25	25	--	50
ITL503	OLAP Lab	-	-	-	-	-	25	25	--	50



**T. E. Information Technology (Semester-VI)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC601	Software Engineering with Project Management	4	-	-	4	-	-	4
ITC602	Data Mining and Business Intelligence	4	-	-	4	-	-	4
ITC603	Cloud Computing & Services	4	-	-	4	-	-	4
ITC604	Wireless Networks	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -II	4	-	-	4	-	-	4
ITL601	Software Design Lab	-	2	-	-	1	-	1
ITL602	Business Intelligence Lab	-	2	-	-	1	-	1
ITL603	Cloud Service Design Lab	-	2	-	-	1	-	1
ITL604	Sensor Network Lab	-	2	-	-	1	-	1
ITM605	Mini-project	-	4	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>12</b>	<b>-</b>	<b>20</b>	<b>6</b>	<b>-</b>	<b>26</b>

**University of Mumbai**

**Program Structure B.E. Information Technology, (Rev. 2016)**

**B. E. Information Technology (Semester-VII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC701	Enterprise Network Design	4	-	-	4	-	-	4
ITC702	Infrastructure Security	4	-	-	4	-	-	4
ITC703	Artificial Intelligence	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO-I	Institute Level Optional Course-I	3	-	-	3	-	-	3
ITL701	Network Design Lab	-	2	-	-	1	-	1
ITL702	Advanced Security Lab	-	2	-	-	1	-	1
ITL703	Intelligence System Lab	-	2	-	-	1	-	1
ITL704	Android Apps Development Lab	-	2	-	-	1	-	1
ITM705	Project-I	-	6/8	-	-	3	-	3
	<b>Total</b>	<b>19</b>	<b>14</b>	<b>-</b>	<b>19</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC801	Big Data Analytics	4	-	-	4	-	-	4
ITC802	Internet of Everything	4	-	-	4	-	-	4
ITDLO-IV	Department Level Optional Course-IV	4	-	-	4	-	-	4
ILO-II	Institute Level Optional Course-II	3	-	-	3	-	-	3
ITL801	Big Data Lab	-	2	-	-	1	-	1
ITL802	Internet of Everything Lab	-	2	-	-	1	-	1
ITL803	DevOps Lab	-	2	-	-	1	-	1
ITL804	R Programming Lab	-	2	-	-	1	-	1
ITM805	Project-II	-	16	-	-	8	-	8
	<b>Total</b>	<b>15</b>	<b>24</b>	<b>-</b>	<b>15</b>	<b>12</b>	<b>-</b>	<b>27</b>

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

- Artificial Intelligence and Data Science
- Artificial Intelligence and Machine Learning
- Cyber Security
- Internet of Things (IoT)
- Data Engineering
- Computer Science and Engineering (Data Science)
- **Computer Science and Engineering (Artificial Intelligence and Machine Learning)**
- Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)

**Second Year with Effect from AY 2021-22**

Under

**FACULTY OF SCIENCE & TECHNOLOGY**

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

AC: 29/6/2021

Item No: 6.23

## UNIVERSITY OF MUMBAI



### Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year Engineering ( Eight New Branches)</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./<del>Diploma</del> / Certificate (Strike out which is not applicable)</b>
7	Pattern	<b><del>Yearly</del> / Semester (Strike out which is not applicable )</b>
8	Status	<b>New / Revised (Strike out which is not applicable )</b>
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2021-2022</b>

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 13 weeks and remaining 2 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 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

# Preface by Board of Studies in Computer Engineering

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Second Year Computer Engineering syllabus effective from the Academic Year 2020-21 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting and challenging.

Computer Engineering is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability.
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

## **Board of Studies in Computer Engineering**

Prof. Sunil Bhirud	: Chairman
Prof. Sunita Patil	: Member
Prof. Leena Raga	: Member
Prof. Subhash Shinde	: Member
Prof. Meera Narvekar	: Member
Prof. Suprtim Biswas	: Member
Prof. Sudhir Sawarkar	: Member
Prof. Dayanand Ingle	: Member
Prof. Satish Ket	: Member



## Program Structure for Second Year Computer Engineering

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	
CSC301	Engineering Mathematics-III	3	--	1*	3	--	1	4	
CSC302	Discrete Structures and Graph Theory	3	--	--	3	--	--	3	
CSC303	Data Structure	3	--	--	3	--	--	3	
CSC304	Digital Logic & Computer Architecture	3	--	--	3	--	--	3	
CSC305	Computer Graphics	3	--	--	3	--	--	3	
CSL301	Data Structure Lab	--	2	--	--	1	--	1	
CSL302	Digital Logic & Computer Architecture Lab	--	2	--	--	1	--	1	
CSL303	Computer Graphics Lab	--	2	--	--	1	--	1	
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	2+2*	--	--	2	--	2	
CSM301	Mini Project – 1 A	--	4 <sup>§</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>07</b>	<b>1</b>	<b>23</b>	
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Pract &amp; oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem. Exam</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test 1</b>	<b>Test 2</b>	<b>Avg</b>					
CSC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
CSC302	Discrete Structures and Graph Theory	20	20	20	80	3	--	--	100
CSC303	Data Structure	20	20	20	80	3	--	--	100
CSC304	Digital Logic & Computer Architecture	20	20	20	80	3	--	--	100
CSC305	Computer Graphics	20	20	20	80	3	--	--	100
CSL301	Data Structure Lab	--	--	--	--	--	25	25	50
CSL302	Digital Logic & Computer Architecture Lab	--	--	--	--	--	25	--	25
CSL303	Computer Graphics Lab	--	--	--	--	--	25	25	50
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	--	--	--	--	50	25	75
CSM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

\*Should be conducted batch wise and

§ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

- Artificial Intelligence and Data Science
- Artificial Intelligence and Machine Learning
- Cyber Security
- Internet of Things (IoT)
- Data Engineering
- **Computer Science and Engineering (Data Science)**
- Computer Science and Engineering (Artificial Intelligence and Machine Learning)
- Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)

**Second Year with Effect from AY 2021-22**

Under

**FACULTY OF SCIENCE & TECHNOLOGY**

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

AC: 29/6/2021

Item No: 6.23

## UNIVERSITY OF MUMBAI



### Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year Engineering ( Eight New Branches)</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./<del>Diploma</del> / Certificate (Strike out which is not applicable)</b>
7	Pattern	<b><del>Yearly</del> / Semester (Strike out which is not applicable )</b>
8	Status	<b>New / Revised (Strike out which is not applicable )</b>
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2021-2022</b>

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 13 weeks and remaining 2 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 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

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Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
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Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

# Preface by Board of Studies in Computer Engineering

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Second Year Computer Engineering syllabus effective from the Academic Year 2020-21 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting and challenging.

Computer Engineering is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability.
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

## **Board of Studies in Computer Engineering**

Prof. Sunil Bhirud	: Chairman
Prof. Sunita Patil	: Member
Prof. Leena Raga	: Member
Prof. Subhash Shinde	: Member
Prof. Meera Narvekar	: Member
Prof. Suprtim Biswas	: Member
Prof. Sudhir Sawarkar	: Member
Prof. Dayanand Ingle	: Member
Prof. Satish Ket	: Member

## Program Structure for Second Year Computer Engineering

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	
CSC301	Engineering Mathematics-III	3	--	1*	3	--	1	4	
CSC302	Discrete Structures and Graph Theory	3	--	--	3	--	--	3	
CSC303	Data Structure	3	--	--	3	--	--	3	
CSC304	Digital Logic & Computer Architecture	3	--	--	3	--	--	3	
CSC305	Computer Graphics	3	--	--	3	--	--	3	
CSL301	Data Structure Lab	--	2	--	--	1	--	1	
CSL302	Digital Logic & Computer Architecture Lab	--	2	--	--	1	--	1	
CSL303	Computer Graphics Lab	--	2	--	--	1	--	1	
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	2+2*	--	--	2	--	2	
CSM301	Mini Project – 1 A	--	4 <sup>§</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>07</b>	<b>1</b>	<b>23</b>	
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Pract &amp; oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem. Exam</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test 1</b>	<b>Test 2</b>	<b>Avg</b>					
CSC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
CSC302	Discrete Structures and Graph Theory	20	20	20	80	3	--	--	100
CSC303	Data Structure	20	20	20	80	3	--	--	100
CSC304	Digital Logic & Computer Architecture	20	20	20	80	3	--	--	100
CSC305	Computer Graphics	20	20	20	80	3	--	--	100
CSL301	Data Structure Lab	--	--	--	--	--	25	25	50
CSL302	Digital Logic & Computer Architecture Lab	--	--	--	--	--	25	--	25
CSL303	Computer Graphics Lab	--	--	--	--	--	25	25	50
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	--	--	--	--	50	25	75
CSM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

\*Should be conducted batch wise and

§ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

**Program Structure for Second Year Computer Engineering**

**UNIVERSITY OF MUMBAI (With Effect from 2020-2021)**

**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CSC401	Engineering Mathematics-IV	3	--	1*	3	--	1	4	
CSC402	Analysis of Algorithm	3	--	--	3	--	--	3	
CSC403	Database Management System	3	--	--	3	--	--	3	
CSC404	Operating System	3	--	--	3	--	--	3	
CSC405	Microprocessor	3	--	--	3	--	--	3	
CSL401	Analysis of Algorithm Lab	--	2	--	--	1	--	1	
CSL402	Database Management System Lab	--	2	--	--	1	--	1	
CSL403	Operating System Lab	--	2	--	--	1	--	1	
CSL404	Microprocessor Lab	--	2	--	--	1	--	1	
CSL405	Skill Base Lab Course: Python Programming	--	2*+2	--	--	2	--	2	
CSM401	Mini Project 1-B	--	4 <sup>\$</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>16</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>24</b>	
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.					
CSC401	Engineering Mathematics - IV	20	20	20	80	3	25	--	125
CSC402	Analysis of Algorithm	20	20	20	80	3	--	--	100
CSC403	Database Management System	20	20	20	80	3	--	--	100
CSC404	Operating System	20	20	20	80	3	--	--	100
CSC405	Microprocessor	20	20	20	80	3	--	--	100
CSL401	Analysis of Algorithm Lab	--	--	--	--	--	25	25	50
CSL402	Database Management System Lab	--	--	--	--	--	25	25	50
CSL403	Operating System Lab	--	--	--	--	--	25	25	50
CSL404	Microprocessor Lab	--	--	--	--	--	25	--	25
CSL405	Skill Base Lab Course: Python Programming	--	--	--	--	--	25	--	25
CSM401	Mini Project 1-B	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

\*Should be conducted batchwise and

\$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups.



Course Code	Course Name	Credits
CSC301	Engineering Mathematics-III	4

**Pre-requisite:** Engineering Mathematics-I, Engineering Mathematics-II

**Course Objectives:** The course aims:

1	To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2	To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills.
3	To understand the concept of complex variables, C-R equations with applications.
4	To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning, and AI.
5	To understand some advanced topics of probability, random variables with their distributions and expectations.

**Course Outcomes:** On successful completion, of course, learner/student will be able to:

1	Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2	Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3	Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
4	Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.
6	Understand the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.

Module	Detailed Contents	Hours
1	<b>Laplace Transform</b>	7
	1.1 Definition of Laplace transform, Condition of Existence of Laplace transform.	
	1.2 Laplace Transform (L) of standard functions like $e^{at}$ , $\sin(at)$ , $\cos(at)$ , $h(at)$ , $\delta(t)$ and $\delta'(t)$ , $a \geq 0$ .	
	1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, Change of Scale, Multiplication by $t$ , Division by $t$ , Laplace Transform of derivatives and integrals (Properties without proof).	
	1.4 Evaluation of real improper integrals by using Laplace Transformation.	
	1.5 <b>Self-learning Topics:</b> Laplace Transform: Periodic functions, Heaviside's Unit Step function, Dirac Delta Function, Special functions (Error and Bessel)	
2	<b>Inverse Laplace Transform</b>	7
	2.1 Definition of Inverse Laplace Transform, Linearity property, Inverse Laplace Transform of standard functions, Inverse Laplace transform using derivatives.	
	2.2 Partial fractions method to find Inverse Laplace transform.	
	2.3 Inverse Laplace transform using Convolution theorem (without proof)	
	2.4 <b>Self-learning Topics:</b> Applications to solve initial and boundary value	

		problems involving ordinary differential equations.	
3	<b>Fourier Series:</b>		7
	3.1	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	
	3.2	Fourier series of periodic function with period $2\pi$ and $2l$ .	
	3.3	Fourier series of even and odd functions.	
	3.4	Half range Sine and Cosine Series.	
	3.5	<b>Self-learning Topics:</b> Orthogonal and orthonormal set of functions, Complex form of Fourier Series, Fourier Transforms.	
4	<b>Complex Variables:</b>		7
	4.1	Function $f(z)$ of complex variable, Limit, Continuity and Differentiability of $f(z)$ , Analytic function: Necessary and sufficient conditions for $f(z)$ to be analytic (without proof).	
	4.2	Cauchy-Riemann equations in Cartesian coordinates (without proof).	
	4.3	Milne-Thomson method: Determine analytic function $f(z)$ when real part (u), imaginary part (v) or its combination (u+v / u-v) is given.	
	4.4	Harmonic function, Harmonic conjugate and Orthogonal trajectories.	
	4.5	<b>Self-learning Topics:</b> Conformal mapping, Linear and Bilinear mappings, cross ratio, fixed points and standard transformations.	
5	<b>Statistical Techniques</b>		6
	5.1	Karl Pearson's coefficient of correlation (r)	
	5.2	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	
	5.3	Lines of regression	
	5.4	Fitting of first- and second-degree curves.	
	5.5	<b>Self-learning Topics:</b> Covariance, fitting of exponential curve.	
6	<b>Probability</b>		6
	6.1	Definition and basics of probability, conditional probability.	
	6.2	Total Probability theorem and Bayes' theorem.	
	6.3	Discrete and continuous random variable with probability distribution and probability density function.	
	6.4	Expectation, Variance, Moment generating function, Raw and central moments up to 4 <sup>th</sup> order.	
	6.5	<b>Self-learning Topics:</b> Skewness and Kurtosis of distribution (data).	

### References:

1	Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
3	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication.
4	Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
5	Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
6	Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

### Term Work:

#### General Instructions:

1	Batch wise tutorials have to be conducted. The number of students per batch will be as per University pattern for practical.
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.
3	A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows:		
1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

**Assessment:**

**Internal Assessment Test:**

The assessment consists of two class tests of 20 marks each. The 1st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2<sup>nd</sup> class test has to be conducted (Internal Assessment II) when an additional 35% syllabus is completed. The duration of each test will be for one hour.

**End Semester Theory Examination:**

1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Course Code	Course Name	Credits
CSC302	Discrete Structures and Graph Theory	3

**Pre-requisite:** Basic Mathematics

**Course Objectives:** The course aims:

1	Cultivate clear thinking and creative problem solving.
2	Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3	To apply graph theory in solving practical problems.
4	Thoroughly prepare for the mathematical aspects of other Computer Engineering courses

**Course Outcomes:** On successful completion, of course, learner/student will be able to:

1	Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2	Ability to reason logically.
3	Ability to understand relations, functions, Diagraph and Lattice.
4	Ability to understand and apply concepts of graph theory in solving real world problems.
5	Understand use of groups and codes in Encoding-Decoding
6	Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions

Module	Detailed Contents	Hours
1	<b>Logic</b>	6
	1.1 Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.	
2	<b>Relations and Functions</b>	6
	2.1 Basic concepts of Set Theory	
	2.2 <b>Relations:</b> Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes	
	2.3 <b>Functions:</b> Definition, Types of functions, Composition of functions, Identity and Inverse function	
3	<b>Posets and Lattice</b>	5
	3.1 Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice	
4	<b>Counting</b>	6
	4.1 Basic Counting Principle-Sum Rule, Product Rule, Inclusion-Exclusion Principle, Pigeonhole Principle	
	4.2 Recurrence relations, Solving recurrence relations	
5	<b>Algebraic Structures</b>	8
	5.1 <b>Algebraic structures with one binary operation:</b> Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism	
	5.2 <b>Algebraic structures with two binary operations:</b> Ring	
	5.3 <b>Coding Theory:</b> Coding, binary information and error detection, decoding and error correction	
6	<b>Graph Theory</b>	8
	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex,	

	Applications.	
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<b>Textbooks:</b>	
1	Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, “Discrete Mathematical Structures”, Pearson Education.
2	C. L. Liu “Elements of Discrete Mathematics”, second edition 1985, McGraw-Hill Book Company. Reprinted 2000.
3	K. H. Rosen, “Discrete Mathematics and applications”, fifth edition 2003, Tata McGraw Hill Publishing Company
<b>References:</b>	
1	Y N Singh, “Discrete Mathematical Structures”, Wiley-India.
2	J. L. Mott, A. Kandel, T. P. Baker, “Discrete Mathematics for Computer Scientists and Mathematicians”, Second Edition 1986, Prentice Hall of India.
3	J. P. Trembley, R. Manohar “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw Hill Publishing Company
4	Seymour Lipschutz, Marc Lars Lipson, “Discrete Mathematics” Schaum’s Outline, McGraw Hill Education.
5	Narsing Deo, “Graph Theory with applications to engineering and computer science”, PHI Publications.
6	P. K. Bisht, H. S. Dhami, “Discrete Mathematics”, Oxford press.

<b>Assessment:</b>	
<b>Internal Assessment Test:</b>	
The assessment consists of two class tests of 20 marks each. The 1 <sup>st</sup> class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2 <sup>nd</sup> class test has to be conducted (Internal Assessment II) when an additional 40% syllabus is completed. The duration of each test will be for one hour.	
<b>End Semester Theory Examination:</b>	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

<b>Useful Links</b>	
1	<a href="https://www.edx.org/learn/discrete-mathematics">https://www.edx.org/learn/discrete-mathematics</a>
2	<a href="https://www.coursera.org/specializations/discrete-mathematics">https://www.coursera.org/specializations/discrete-mathematics</a>
3	<a href="https://nptel.ac.in/courses/106/106/106106094/">https://nptel.ac.in/courses/106/106/106106094/</a>
4	<a href="https://swayam.gov.in/nd1_noc19_cs67/preview">https://swayam.gov.in/nd1_noc19_cs67/preview</a>

Course Code	Course Name	Credit
CSC303	Data Structure	03

<b>Pre-requisite: C Programming</b>	
<b>Course Objectives:</b> The course aims:	
1	To understand the need and significance of Data structures as a computer Professional.
2	To teach concept and implementation of linear and Nonlinear data structures.
3	To analyze various data structures and select the appropriate one to solve a specific real-world problem.
4	To introduce various techniques for representation of the data in the real world.
5	To teach various searching techniques.
<b>Course Outcomes:</b>	
1	Students will be able to implement Linear and Non-Linear data structures.
2	Students will be able to handle various operations like searching, insertion, deletion and traversals on various data structures.
3	Students will be able to explain various data structures, related terminologies and its types.
4	Students will be able to choose appropriate data structure and apply it to solve problems in various domains.
5	Students will be able to analyze and Implement appropriate searching techniques for a given problem.
6	Students will be able to demonstrate the ability to analyze, design, apply and use data structures to solve engineering problems and evaluate their solutions.

Module	Detailed Content	Hours
1	<b>Introduction to Data Structures</b>	2
	1.1 Introduction to Data Structures, Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures.	
2	<b>Stack and Queues</b>	8
	2.1 Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion.	
	2.2 Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.	
3	<b>Linked List</b>	10
	3.1 Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.	
4	<b>Trees</b>	11
	4.1 Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.	
5	<b>Graphs</b>	4

	5.1	Introduction, Graph Terminologies, Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-Topological Sorting.	
<b>6</b>		<b>Searching Techniques</b>	4
	6.1	Linear Search, Binary Search, Hashing-Concept, Hash Functions, Collision resolution Techniques	

**Textbooks:**

1	Aaron M Tenenbaum, Yedidiah Langsam, Moshe J Augenstein, “Data Structures Using C”, Pearson Publication.
2	Reema Thareja, “Data Structures using C”, Oxford Press.
3	Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2 <sup>nd</sup> Edition, CENGAGE Learning.
4	Jean Paul Tremblay, P. G. Sorenson, “Introduction to Data Structure and Its Applications”, McGraw-Hill Higher Education
5	Data Structures Using C, ISRD Group, 2 <sup>nd</sup> Edition, Tata McGraw-Hill.

**References:**

1	Prof. P. S. Deshpande, Prof. O. G. Kakde, “C and Data Structures”, DreamTech press.
2	E. Balagurusamy, “Data Structure Using C”, Tata McGraw-Hill Education India.
3	Rajesh K Shukla, “Data Structures using C and C++”, Wiley-India
4	GAV PAI, “Data Structures”, Schaum’s Outlines.
5	Robert Kruse, C. L. Tondo, Bruce Leung, “Data Structures and Program Design in C”, Pearson Edition

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Useful Links**

1	<a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a>
2	<a href="https://www.coursera.org/specializations/data-structures-algorithms">https://www.coursera.org/specializations/data-structures-algorithms</a>
3	<a href="https://www.edx.org/course/data-structures-fundamentals">https://www.edx.org/course/data-structures-fundamentals</a>
4	<a href="https://swayam.gov.in/nd1_noc19_cs67/preview">https://swayam.gov.in/nd1_noc19_cs67/preview</a>

<b>Course Code</b>	<b>Course Name</b>	<b>Credit</b>
<b>CSC304</b>	<b>Digital Logic &amp; Computer Organization and Architecture</b>	<b>3</b>

**Pre-requisite:** Knowledge on number systems

**Course Objective:**

1	To have the rough understanding of the basic structure and operation of basic digital circuits and digital computer.
2	To discuss in detail arithmetic operations in digital system.
3	To discuss generation of control signals and different ways of communication with I/O devices.
4	To study the hierarchical memory and principles of advanced computing.

**Course Outcome:**

1	To learn different number systems and basic structure of computer system.
2	To demonstrate the arithmetic algorithms.
3	To understand the basic concepts of digital components and processor organization.
4	To understand the generation of control signals of computer.
5	To demonstrate the memory organization.
6	To describe the concepts of parallel processing and different Buses.

<b>Module</b>	<b>Detailed Content</b>	<b>Hours</b>
<b>1</b>	<b>Computer Fundamentals</b>	<b>5</b>
	1.1 Introduction to Number System and Codes	
	1.2 Number Systems: Binary, Octal, Decimal, Hexadecimal,	
	1.3 Codes: Grey, BCD, Excess-3, ASCII, Boolean Algebra.	
	1.4 Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR	
	1.5 Overview of computer organization and architecture.	
	1.6 Basic Organization of Computer and Block Level functional Units, Von-Neumann Model.	
<b>2</b>	<b>Data Representation and Arithmetic algorithms</b>	<b>8</b>
	2.1 Binary Arithmetic: Addition, Subtraction, Multiplication, Division using Sign Magnitude, 1's and 2's compliment, BCD and Hex Arithmetic Operation.	
	2.2 Booths Multiplication Algorithm, Restoring and Non-restoring Division Algorithm.	
	2.3 IEEE-754 Floating point Representation.	
<b>3</b>	<b>Processor Organization and Architecture</b>	<b>6</b>
	3.1 Introduction: Half adder, Full adder, MUX, DMUX, Encoder, Decoder(IC level).	
	3.2 Introduction to Flip Flop: SR, JK, D, T (Truth table).	
	3.3 Register Organization, Instruction Formats, Addressing modes, Instruction Cycle, Interpretation and sequencing.	
<b>4</b>	<b>Control Unit Design</b>	<b>6</b>
	4.1 Hardwired Control Unit: State Table Method, Delay Element Methods.	
	4.2 Microprogrammed Control Unit: Micro Instruction-Format, Sequencing and execution, Micro operations, Examples of microprograms.	
<b>5</b>	<b>Memory Organization</b>	<b>6</b>
	5.1 Introduction and characteristics of memory, Types of RAM and ROM, Memory Hierarchy, 2-level Memory Characteristic,	
	5.2 Cache Memory: Concept, locality of reference, Design problems based on	



		mapping techniques, Cache coherence and write policies. Interleaved and Associative Memory.	
<b>6</b>		<b>Principles of Advanced Processor and Buses</b>	<b>8</b>
	6.1	Basic Pipelined Data path and control, data dependencies, data hazards, branch hazards, delayed branch, and branch prediction, Performance measures-CPI, Speedup, Efficiency, throughput, Amdhal's law.	
	6.2	Flynn's Classification, Introduction to multicore architecture.	
	6.3	Introduction to buses: ISA, PCI, USB. Bus Contention and Arbitration.	

**Textbooks:**

1	R. P. Jain, "Modern Digital Electronic", McGraw-Hill Publication, 4 <sup>th</sup> Edition.
2	William Stalling, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10 <sup>TH</sup> Edition.
3	John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3 <sup>RD</sup> Edition.
4	Dr. M. Usha and T. S. Shrikanth, "Computer system Architecture and Organization", Wiley publication.

**References:**

1	Andrew S. Tanenbaum, "Structured Computer Organization", Pearson Publication.
2	B. Govindarajalu, "Computer Architecture and Organization", McGraw-Hill Publication.
3	Malvino, "Digital computer Electronics", McGraw-Hill Publication, 3 <sup>rd</sup> Edition.
4	Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw-Hill Publication.

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Useful Links**

1	<a href="https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824">https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824</a>
2	<a href="https://nptel.ac.in/courses/106/103/106103068/">https://nptel.ac.in/courses/106/103/106103068/</a>
3	<a href="https://www.coursera.org/learn/comparch">https://www.coursera.org/learn/comparch</a>
4	<a href="https://www.edx.org/learn/computer-architecture">https://www.edx.org/learn/computer-architecture</a>

Course Code	Course Name	Credits
CSC305	Computer Graphics	3

**Prerequisite:** Knowledge of C Programming and Basic Mathematics.

**Course Objectives**

1	To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics.
2	To emphasize on implementation aspect of Computer Graphics Algorithms.
3	To prepare the student for advance areas and professional avenues in the field of Computer Graphics

**Course Outcomes:** At the end of the course, the students should be able to

1	Describe the basic concepts of Computer Graphics.
2	Demonstrate various algorithms for basic graphics primitives.
3	Apply 2-D geometric transformations on graphical objects.
4	Use various Clipping algorithms on graphical objects
5	Explore 3-D geometric transformations, curve representation techniques and projections methods.
6	Explain visible surface detection techniques and Animation.

Module		Detailed Content	Hours
<b>1</b>		<b>Introduction and Overview of Graphics System:</b>	<b>02</b>
	1.1	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, rasterization and rendering.	
	1.2	Raster scan & random scan displays, Architecture of raster graphics system with display processor, Architecture of random scan systems.	
<b>2</b>		<b>Output Primitives:</b>	<b>10</b>
	2.1	Scan conversions of point, line, circle and ellipse: DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected)	
	2.2	Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing).	
	2.3	Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm.	
<b>3</b>		<b>Two Dimensional Geometric Transformations</b>	<b>6</b>
	3.1	Basic transformations: Translation, Scaling, Rotation	
	3.2	Matrix representation and Homogeneous Coordinates	
	3.3	Composite transformation	
	3.4	Other transformations: Reflection and Shear	
<b>4</b>		<b>Two-Dimensional Viewing and Clipping</b>	<b>7</b>
	4.1	Viewing transformation pipeline and Window to Viewport coordinate transformation	
	4.2	Clipping operations: Point clipping, Line clipping algorithms: Cohen-Sutherland, Liang: Barsky, Polygon Clipping Algorithms: Sutherland-Hodgeman, Weiler-Atherton.	
<b>5</b>		<b>Three Dimensional Geometric Transformations, Curves and Fractal Generation</b>	<b>8</b>
	5.1	3D Transformations: Translation, Rotation, Scaling and Reflection	

	5.2	Composite transformations: Rotation about an arbitrary axis	
	5.3	Projections – Parallel, Perspective. (Matrix Representation)	
	5.4	Bezier Curve, B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve.	
<b>6</b>		<b>Visible Surface Detection and Animation</b>	<b>6</b>
	6.1	Visible Surface Detection: Classification of Visible Surface Detection algorithm, Back Surface detection method, Depth Buffer method, Area Subdivision method	
	6.2	Animation: Introduction to Animation, Traditional Animation Techniques, Principles of Animation, Key framing: Character and Facial Animation, Deformation, Motion capture	

<b>Textbooks:</b>	
1	Hearn & Baker, “Computer Graphics C version”, 2nd Edition, Pearson Publication
2	James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, “Computer Graphics Principles and Practice in C”, 2 <sup>nd</sup> Edition, Pearson Publication
3	Samit Bhattacharya, “Computer Graphics”, Oxford Publication
<b>References:</b>	
1	D. Rogers, “Procedural Elements for Computer Graphics”, Tata McGraw-Hill Publications.
2	Zhigang Xiang, Roy Plastock, “Computer Graphics”, Schaum’s Outlines McGraw-Hill Education
3	Rajesh K. Maurya, “Computer Graphics”, Wiley India Publication.
4	F. S. Hill, “Computer Graphics using OpenGL”, Third edition, Pearson Publications.

<b>Assessment:</b>	
<b>Internal Assessment:</b>	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
<b>End Semester Theory Examination:</b>	
1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules

<b>Useful Links</b>	
1	<a href="https://www.classcentral.com/course/interactivegraphics-2067">https://www.classcentral.com/course/interactivegraphics-2067</a>
2	<a href="https://swayam.gov.in/nd2_ntr20_ed15/preview">https://swayam.gov.in/nd2_ntr20_ed15/preview</a>
3	<a href="https://nptel.ac.in/courses/106/106/106106090/">https://nptel.ac.in/courses/106/106/106106090/</a>
4	<a href="https://www.edx.org/course/computer-graphics-2">https://www.edx.org/course/computer-graphics-2</a>

<b>Lab Code</b>	<b>Lab Name</b>	<b>Credit</b>
CSL301	Data Structures Lab	1

**Prerequisite: C Programming Language.**

**Lab Objectives:**

1	To implement basic data structures such as arrays, linked lists, stacks and queues
2	Solve problem involving graphs, and trees
3	To develop application using data structure algorithms
4	Compute the complexity of various algorithms.

**Lab Outcomes:**

1	Students will be able to implement linear data structures & be able to handle operations like insertion, deletion, searching and traversing on them.
2	Students will be able to implement nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them
3	Students will be able to choose appropriate data structure and apply it in various problems
4	Students will be able to select appropriate searching techniques for given problems.

**Suggested Experiments:** Students are required to complete at least 10 experiments.

Star (\*) marked experiments are compulsory.

Sr. No.	Name of the Experiment
1*	Implement Stack ADT using array.
2*	Convert an Infix expression to Postfix expression using stack ADT.
3*	Evaluate Postfix Expression using Stack ADT.
4	Applications of Stack ADT.
5*	Implement Linear Queue ADT using array.
6*	Implement Circular Queue ADT using array.
7	Implement Priority Queue ADT using array.
8*	Implement Singly Linked List ADT.
9*	Implement Circular Linked List ADT.
10	Implement Doubly Linked List ADT.
11*	Implement Stack / Linear Queue ADT using Linked List.
12*	Implement Binary Search Tree ADT using Linked List.
13*	Implement Graph Traversal techniques: a) Depth First Search b) Breadth First Search
14	Applications of Binary Search Technique.

**Useful Links:**

1	<a href="http://www.leetcode.com">www.leetcode.com</a>
2	<a href="http://www.hackerrank.com">www.hackerrank.com</a>
3	<a href="http://www.cs.usfca.edu/~galles/visualization/Algorithms.html">www.cs.usfca.edu/~galles/visualization/Algorithms.html</a>
4	<a href="http://www.codechef.com">www.codechef.com</a>

**Term Work:**

1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

**Oral & Practical exam**

Based on the entire syllabus of CSL301 and CSC303

Lab Code	Lab Name	Credit
CSL302	Digital Logic & Computer Organization and Architecture Lab	1

**Prerequisite: C Programming Language.**

**Lab Objectives:**

- |   |  |
|---|--|
| 1 | To implement operations of the arithmetic unit using algorithms. |
| 2 | Design and simulate different digital circuits.                  |
| 3 | To design memory subsystem including cache memory.               |
| 4 | To demonstrate CPU and ALU design.                               |

**Lab Outcomes:**

- |   |  |
|---|--|
| 1 | To understand the basics of digital components                                 |
| 2 | Design the basic building blocks of a computer: ALU, registers, CPU and memory |
| 3 | To recognize the importance of digital systems in computer architecture        |
| 4 | To implement various algorithms for arithmetic operations.                     |

**List of Experiments:**

Sr. No.	Name of the Experiment
1	To verify the truth table of various logic gates using ICs.
2	To realize the gates using universal gates
3	Code conversion.
4	To realize half adder and full adder.
5	To implement logic operation using MUX IC.
6	To implement logic operation decoder IC.
7	Study of flip flop IC.
8	To implement ripple carry adder.
9	To implement carry look ahead adder.
10	To implement Booth's algorithm.
11	To implement restoring division algorithm.
12	To implement non restoring division algorithm.
13	To implement ALU design.
14	To implement CPU design.
15	To implement memory design.
16	To implement cache memory design.

**Note:**

- |   |  |
|---|--|
| 1 | Any Four experiments from Exp. No. 1 to Exp. No. 7 using hardware.                                 |
| 2 | Any Six experiments from Exp. No. 8 to Exp. No. 16 using Virtual Lab, except Exp. No 10,11 and 12. |
| 3 | Exp. No. 10 to Exp. No. 12 using Programming language.   |

**Digital Material:**

- |   |   |
|---|---|
| 1 | <a href="#">Manual to use Virtual Lab simulator for Computer Organization and Architecture developed by the Department of CSE, IIT Kharagpur.</a> |
| 2 | <a href="http://cse10-iitkgp.virtual-labs.ac.in/">Link http://cse10-iitkgp.virtual-labs.ac.in/</a>  |

**Term Work:**

- |   |  |
|---|--|
| 1 | Term work should consist of 10 experiments.  |
| 2 | Journal must include at least 2 assignments on content of theory and practical of "Digital Logic & Computer Organization and Architecture"           |
| 3 | The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. |

4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
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<b>Course Code</b>	<b>Lab Name</b>	<b>Credits</b>
<b>CSL303</b>	<b>Computer Graphics Lab</b>	<b>1</b>

**Prerequisite: C Programming Language.**

**Lab Objectives:**

- |   |  |
|---|--|
| 1 | Understand the need of developing graphics application                               |
| 2 | Learn algorithmic development of graphics primitives like line, circle, polygon etc. |
| 3 | Learn the representation and transformation of graphical images and pictures         |

**Lab Outcomes:** At the end of the course, the students should be able to

- |   |  |
|---|--|
| 1 | Implement various output and filled area primitive algorithms                  |
| 2 | Apply transformation, projection and clipping algorithms on graphical objects. |
| 3 | Perform curve and fractal generation methods.                                  |
| 4 | Develop a Graphical application/Animation based on learned concept             |

**Content:**

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation Curves Visible surface determination. Simple animations Application of these through exercises in C/C++

**List of Suggested Experiments:**

<b>Sr. No.</b>	<b>Name of the Experiment</b>
1	Implement DDA Line Drawing algorithm (dotted/dashed/thick)
2	Implement Bresenham's Line algorithm(dotted/dashed/thick)
3	Implement midpoint Circle algorithm.
4	Implement midpoint Ellipse algorithm.
5	Implement Area Filling Algorithm: Boundary Fill, Flood Fill.
6	Implement Scan line Polygon Filling algorithm.
7	Implement Curve: Bezier for n control points, B Spline (Uniform)(at least one)
8	Implement Fractal generation method (anyone)
9	Character Generation: Bit Map method and Stroke Method
10	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.
11	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.
12	Implement polygon clipping algorithm (at least one)
13	Program to perform 3D transformation.
14	Perform projection of a 3D object on Projection Plane: Parallel and Perspective.
15	Perform Animation (such as Rising Sun, Moving Vehicle, Smileys, Screen saver etc.)

**Term Work:**

- |   |  |
|---|--|
| 1 | Term work should consist of 10 experiments.  |
| 2 | Journal must include at least 2 assignments  |
| 3 | Mini Project to perform using C /C++/Java/OpenGL/Blender/ any other tool (2/3 students per group). Possible Ideas: Animation using multiple objects, Game development, Graphics editor: Like Paint brush, Text editor etc. |
| 4 | The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.   |
| 5 | Total 25 Marks (Experiments: 10-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks, Mini Project: 5-marks)   |

**Oral & Practical exam**

	Based on the above contents and entire syllabus of CSC305
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Lab Code	Lab Name	Credits
CSL304	Skill based Lab Course: Object Oriented Programming with Java	2

<b>Prerequisite:</b> Structured Programming Approach	
<b>Lab Objectives:</b>	
1	To learn the basic concepts of object-oriented programming
2	To study JAVA programming language
3	To study various concepts of JAVA programming like multithreading, exception Handling, packages, etc.
4	To explain components of GUI based programming.
<b>Lab Outcomes:</b> At the end of the course, the students should be able to	
1	To apply fundamental programming constructs.
2	To illustrate the concept of packages, classes and objects.
3	To elaborate the concept of strings, arrays and vectors.
4	To implement the concept of inheritance and interfaces.
5	To implement the concept of exception handling and multithreading.
6	To develop GUI based application.

Module		Detailed Content	Hours
<b>1</b>		<b>Introduction to Object Oriented Programming</b>	<b>2</b>
	1.1	OOP concepts: Objects, class, Encapsulation, Abstraction, Inheritance, Polymorphism, message passing.	
	1.2	Java Virtual Machine	
	1.3	Basic programming constructs: variables, data types, operators, unsigned right shift operator, expressions, branching and looping.	
<b>2</b>		<b>Class, Object, Packages and Input/output</b>	<b>6</b>
	2.1	Class, object, data members, member functions Constructors, types, static members and functions Method overloading Packages in java, types, user defined packages Input and output functions in Java, Buffered reader class, scanner class	
<b>3</b>		<b>Array, String and Vector</b>	<b>3</b>
	3.1	Array, Strings, String Buffer, Vectors	
<b>4</b>		<b>Inheritance</b>	<b>4</b>
	4.1	Types of inheritance, Method overriding, super, abstract class and abstract method, final, Multiple inheritance using interface, extends keyword	
<b>5</b>		<b>Exception handling and Multithreading</b>	<b>5</b>
	5.1	Exception handling using try, catch, finally, throw and throws, Multiple try and catch blocks, user defined exception Thread lifecycle, thread class methods, creating threads using extends and implements keyword.	
<b>6</b>		<b>GUI programming in JAVA</b>	<b>6</b>
	6.1	Applet and applet life cycle, creating applets, graphics class functions, parameter passing to applet, Font and color class. Event handling using event class AWT: working with windows, using AWT controls for GUI design Swing class in JAVA	



	Introduction to JDBC, JDBC-ODBC connectivity, JDBC architecture.	
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<b>Textbooks:</b>	
1	Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2	E. Balagurusamy, 'Programming with Java', McGraw Hill Education.
<b>References:</b>	
1	Ivor Horton, "Beginning JAVA", Wiley India.
2	Diatal and Diatal, "Java: How to Program", 8 <sup>th</sup> Edition, PHI .
3	"JAVA Programming", Black Book, Dreamtech Press.
4	"Learn to Master Java programming", Staredu solutions
<b>Digital material:</b>	
1	<a href="http://www.nptelvideos.in">www.nptelvideos.in</a>
2	<a href="http://www.w3schools.com">www.w3schools.com</a>
3	<a href="http://www.tutorialspoint.com">www.tutorialspoint.com</a>
4	<a href="https://starcertification.org/Certifications/Certificate/securejava">https://starcertification.org/Certifications/Certificate/securejava</a>

<b>Suggested List of Programming Assignments/laboratory Work:</b>	
<b>Sr. No.</b>	<b>Name of the Experiment</b>
1	Programs on Basic programming constructs like branching and looping
2	Program on accepting input through keyboard.
3	Programs on class and objects
4	Program on method and constructor overloading.
5	Program on Packages
6	Program on 2D array, strings functions
7	Program on String Buffer and Vectors
8	Program on types of inheritance
9	Program on Multiple Inheritance
10	Program on abstract class and abstract methods.
11	Program using super and final keyword
12	Program on Exception handling
13	Program on user defined exception
14	Program on Multithreading
15	Program on Graphics class
16	Program on applet class
17	Program to create GUI application
18	Mini Project based on the content of the syllabus (Group of 2-3 students)

<b>Term Work:</b>	
1	Term work should consist of 15 experiments.
2	Journal must include at least 2 assignments
3	Mini Project based on the content of the syllabus (Group of 2-3 students)
4	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 50-Marks (Experiments: 15-marks, Attendance: 05-marks, Assignments: 05-marks, Mini Project: 20-marks, MCQ as a part of lab assignments: 5-marks)

<b>Oral &amp; Practical exam</b>
Based on the entire syllabus of CSL 304: <b>Skill based Lab Course: Object Oriented Programming with Java</b>

Course code	Course Name	Credits
CSM301	Mini Project A	02

<b>Objectives</b>	
1	To acquaint with the process of identifying the needs and converting it into the problem.
2	To familiarize the process of solving the problem in a group.
3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4	To inculcate the process of self-learning and research.
<b>Outcome:</b> Learner will be able to...	
1	Identify problems based on societal /research needs.
2	Apply Knowledge and skill to solve societal problems in a group.
3	Develop interpersonal skills to work as member of a group or leader.
4	Draw the proper inferences from available results through theoretical/experimental/simulations.
5	Analyze the impact of solutions in societal and environmental context for sustainable development.
6	Use standard norms of engineering practices
7	Excel in written and oral communication.
8	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9	Demonstrate project management principles during project work.
<b>Guidelines for Mini Project</b>	
1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

<b>Term Work</b>		
The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.		
In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.		
<b>Distribution of Term work marks for both semesters shall be as below:</b>		<b>Marks</b>
1	Marks awarded by guide/supervisor based on logbook	10
2	Marks awarded by review committee	10
3	Quality of Project report	05
<b>Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines</b>		
<b>One-year project:</b>		
1	In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group. <ul style="list-style-type: none"> <li>• First shall be for finalization of problem</li> <li>• Second shall be on finalization of proposed solution of problem.</li> </ul>	
2	In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester. <ul style="list-style-type: none"> <li>• First review is based on readiness of building working prototype to be conducted.</li> <li>• Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.</li> </ul>	
<b>Half-year project:</b>		
1	In this case in one semester students' group shall complete project in all aspects including, <ul style="list-style-type: none"> <li>• Identification of need/problem</li> <li>• Proposed final solution</li> <li>• Procurement of components/systems</li> <li>• Building prototype and testing</li> </ul>	
2	Two reviews will be conducted for continuous assessment, <ul style="list-style-type: none"> <li>• First shall be for finalization of problem and proposed solution</li> <li>• Second shall be for implementation and testing of solution.</li> </ul>	
<b>Assessment criteria of Mini Project.</b>		
<b>Mini Project</b> shall be assessed based on following criteria;		
1	Quality of survey/ need identification	
2	Clarity of Problem definition based on need.	
3	Innovativeness in solutions	
4	Feasibility of proposed problem solutions and selection of best solution	
5	Cost effectiveness	
6	Societal impact	
7	Innovativeness	
8	Cost effectiveness and Societal impact	
9	Full functioning of working model as per stated requirements	

10	Effective use of skill sets
11	Effective use of standard engineering norms
12	Contribution of an individual's as member or leader
13	Clarity in written and oral communication
	In <b>one year, project</b> , first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
	In case of <b>half year project</b> all criteria's in generic may be considered for evaluation of performance of students in mini project.
<b>Guidelines for Assessment of Mini Project Practical/Oral Examination:</b>	
1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
<b>Mini Project</b> shall be assessed based on following points;	
1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Full functioning of working model as per stated requirements
5	Effective use of skill sets
6	Effective use of standard engineering norms
7	Contribution of an individual's as member or leader
8	Clarity in written and oral communication

Course Code	Course Name	Credits
CSC401	Engineering Mathematics-IV	4

**Pre-requisite:** Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Binomial Distribution.

**Course Objectives:** The course aims to learn:

- 1 Matrix algebra to understand engineering problems.
- 2 Line and Contour integrals and expansion of a complex valued function in a power series.
- 3 Z-Transforms and Inverse Z-Transforms with its properties.
- 4 The concepts of probability distributions and sampling theory for small samples.
- 5 Linear and Non-linear programming problems of optimization.

**Course Outcomes:** On successful completion, of course, learner/student will be able to:

- 1 Apply the concepts of eigenvalues and eigenvectors in engineering problems.
- 2 Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
- 3 Apply the concept of Z- transformation and inverse in engineering problems.
- 4 Use the concept of probability distribution and sampling theory to engineering problems.
- 5 Apply the concept of Linear Programming Problems to optimization.
- 6 Solve Non-Linear Programming Problems for optimization of engineering problems.

Module	Detailed Contents	Hours
1	<b>Linear Algebra (Theory of Matrices)</b>	7
	1.1 Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof)	
	1.2 Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials	
	1.3 Similarity of matrices, diagonalizable and non-diagonalizable matrices	
	1.4 <b>Self-learning Topics:</b> Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.	
2	<b>Complex Integration</b>	7
	2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).	
	2.2 Taylor's and Laurent's series (without proof).	
	2.3 Definition of Singularity, Zeroes, poles of $f(z)$ , Residues, Cauchy's Residue Theorem (without proof)	
	2.4 <b>Self-learning Topics:</b> Application of Residue Theorem to evaluate real integrations.	
3	<b>Z Transform</b>	5
	3.1 Definition and Region of Convergence, Transform of Standard Functions: $\{\square^{\square}\square^{\square}\}, \{\square^{ \square }\}, \{\square^{+\square}\square.\square^{\square}\}, \{\square^{\square}\sin(\square\square + \square)\}, \{\square^{\square}\sinh \square\square\}, \{\square^{\square}\cosh \square\square\}.$	
	3.2 Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem.	
	3.3 Inverse Z transform: Partial Fraction Method, Convolution Method.	
	3.4 <b>Self-learning Topics:</b> Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion	
4	<b>Probability Distribution and Sampling Theory</b>	7
	4.1 Probability Distribution: Poisson and Normal distribution	

	4.2	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.	
	4.3	Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Chi-Square Test: Test of goodness of fit and independence of attributes, Contingency table.	
	4.4	<b>Self-learning Topics:</b> Test significance for Large samples, Estimate parameters of a population, Yate's Correction.	
5	<b>Linear Programming Problems</b>		6
	5.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.	
	5.2	Artificial variables, Big-M method (Method of penalty)	
	5.3	Duality, Dual of LPP and Dual Simplex Method	
	5.4	<b>Self-learning Topics:</b> Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	
6	<b>Nonlinear Programming Problems</b>		7
	6.1	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers	
	6.2	NLPP with two equality constraints	
	6.3	NLPP with inequality constraint: Kuhn-Tucker conditions	
	6.4	<b>Self-learning Topics:</b> Problems with two inequality constraints, Unconstrained optimization: One-dimensional search method (Golden Search method, Newton's method). Gradient Search method	

#### References:

1	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons.
2	R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa.
3	Brown and Churchill, "Complex Variables and Applications", McGraw-Hill Education.
4	T. Veerarajan, "Probability, Statistics and Random Processes", McGraw-Hill Education.
5	Hamdy A Taha, "Operations Research: An Introduction", Pearson.
6	S.S. Rao, "Engineering Optimization: Theory and Practice", Wiley-Blackwell.
7	Hira and Gupta, "Operations Research", S. Chand Publication.

#### Term Work:

##### General Instructions:

1	Batch wise tutorial shave to be conducted. The number of students per batch will be as per University pattern for practical.
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.
3	A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.

##### The distribution of Term Work marks will be as follows:

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

#### Assessment:

##### Internal Assessment Test:

The assessment consists of two class tests of 20 marks each. The 1st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2<sup>nd</sup> class test has to be conducted (Internal Assessment II) when an additional 35% syllabus is

completed. The duration of each test will be for one hour.

**End Semester Theory Examination:**

1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Course Code	Course Name	Credit
CSC402	Analysis of Algorithms	3

**Prerequisite:** Data structure concepts, Discrete structures

**Course Objectives:**

- |   |   |
|---|---|
| 1 | To provide mathematical approaches for Analysis of Algorithms         |
| 2 | To understand and solve problems using various algorithmic approaches |
| 3 | To analyze algorithms using various methods                           |

**Course Outcomes:** At the end of the course learner will be able to

- |   |   |
|---|---|
| 1 | Analyze the running time and space complexity of algorithms.                |
| 2 | Describe, apply and analyze the complexity of divide and conquer strategy.  |
| 3 | Describe, apply and analyze the complexity of greedy strategy.              |
| 4 | Describe, apply and analyze the complexity of dynamic programming strategy. |
| 5 | Explain and apply backtracking, branch and bound.                           |
| 6 | Explain and apply string matching techniques.                               |

Module		Detailed Contents	Hours
1		<b>Introduction</b>	8
	1.1	Performance analysis, space, and time complexity Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis. Complexity class: Definition of P, NP, NP-Hard, NP-Complete Analysis of selection sort, insertion sort.	
	1.2	Recurrences: The substitution method, Recursion tree method, Master method	
2		<b>Divide and Conquer Approach</b>	6
	2.1	General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search.	
3		<b>Greedy Method Approach</b>	6
	3.1	General Method, Single source shortest path: Dijkstra Algorithm Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms	
4		<b>Dynamic Programming Approach</b>	9
	4.1	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm All pair shortest path: Floyd Warshall Algorithm, Assembly-line scheduling Problem 0/1 knapsack Problem, Travelling Salesperson problem, Longest common subsequence	
5		<b>Backtracking and Branch and bound</b>	6
	5.1	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring	
	5.2	Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem	
6		<b>String Matching Algorithms</b>	4
	6.1	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	

**Textbooks:**

- |   |  |
|---|--|
| 1 | T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2 <sup>nd</sup> Edition, PHI Publication 2005. |
| 2 | Ellis Horowitz, Sartaj Sahni, S. Rajsekar. "Fundamentals of computer algorithms" University Press.                                     |



**References:**

1	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.
2	S. K. Basu, "Design Methods and Analysis of Algorithm", PHI

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four question need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

**Useful Links**

1	<a href="https://nptel.ac.in/courses/106/106/106106131/">https://nptel.ac.in/courses/106/106/106106131/</a>
2	<a href="https://swayam.gov.in/nd1_noc19_cs47/preview">https://swayam.gov.in/nd1_noc19_cs47/preview</a>
3	<a href="https://www.coursera.org/specializations/algorithms">https://www.coursera.org/specializations/algorithms</a>
4	<a href="https://www.mooc-list.com/tags/algorithms">https://www.mooc-list.com/tags/algorithms</a>

<b>Course Code:</b>	<b>Course Title</b>	<b>Credit</b>
<b>CSC403</b>	<b>Database Management System</b>	<b>3</b>

<b>Prerequisite: Data Structures</b>	
<b>Course Objectives:</b>	
1	Develop entity relationship data model and its mapping to relational model
2	Learn relational algebra and Formulate SQL queries
3	Apply normalization techniques to normalize the database
4	Understand concept of transaction, concurrency control and recovery techniques.
<b>Course Outcomes:</b>	
1	Recognize the need of database management system
2	Design ER and EER diagram for real life applications
3	Construct relational model and write relational algebra queries.
4	Formulate SQL queries
5	Apply the concept of normalization to relational database design.
6	Describe the concept of transaction, concurrency and recovery.

<b>Module</b>	<b>Content</b>	<b>Hrs</b>
<b>1</b>	<b>Introduction Database Concepts</b>	<b>3</b>
	1.1 Introduction, Characteristics of databases, File system v/s Database system, Data abstraction and data Independence, DBMS system architecture, Database Administrator	
<b>2</b>	<b>Entity–Relationship Data Model</b>	<b>6</b>
	2.1 The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation	
<b>3</b>	<b>Relational Model and relational Algebra</b>	<b>8</b>
	3.1 Introduction to the Relational Model, relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model, Relational Algebra-operators, Relational Algebra Queries.	
<b>4</b>	<b>Structured Query Language (SQL)</b>	<b>6</b>
	4.1 Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity , check constraints, Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers	
<b>5</b>	<b>Relational-Database Design</b>	<b>6</b>
	5.1 Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF.	
<b>6</b>	<b>Transactions Management and Concurrency and Recovery</b>	<b>10</b>
	6.1 Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling	

<b>Textbooks:</b>	
1	Korth, Slberchatz, Sudarshan, Database System Concepts, 6 <sup>th</sup> Edition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5 <sup>th</sup> Edition, Pearson Education
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
<b>References:</b>	
1	Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5 <sup>th</sup> Edition.
2	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3	G. K. Gupta, Database Management Systems, McGraw Hill, 2012

<b>Assessment:</b>	
<b>Internal Assessment:</b>	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
<b>End Semester Theory Examination:</b>	
1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four question need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

<b>Useful Links</b>	
1	<a href="https://nptel.ac.in/courses/106/105/106105175/">https://nptel.ac.in/courses/106/105/106105175/</a>
2	<a href="https://swayam.gov.in/nd1_noc19_cs46/preview">https://swayam.gov.in/nd1_noc19_cs46/preview</a>
3	<a href="https://www.classcentral.com/course/swayam-database-management-system-9914">https://www.classcentral.com/course/swayam-database-management-system-9914</a>
4	<a href="https://www.mooc-list.com/tags/dbms">https://www.mooc-list.com/tags/dbms</a>

Course Code	Course Name	Credit
CSC404	Operating System	03

**Prerequisites: Data structures and Computer architecture**

**Course Objectives:**

1	1. To introduce basic concepts and functions of operating systems.
2	2. To understand the concept of process, thread and resource management.
3	3. To understand the concepts of process synchronization and deadlock.
4	4. To understand various Memory, I/O and File management techniques.

**Course Outcome:**

1	Understand the objectives, functions and structure of OS
2	Analyze the concept of process management and evaluate performance of process scheduling algorithms.
3	Understand and apply the concepts of synchronization and deadlocks
4	Evaluate performance of Memory allocation and replacement policies
5	Understand the concepts of file management.
	Apply concepts of I/O management and analyze techniques of disk scheduling.

Module	Detailed Content	Hours
<b>1</b>	<b>Operating system Overview</b>	<b>4</b>
	1.1 Introduction, Objectives, Functions and Evolution of Operating System	
	1.2 Operating system structures: Layered, Monolithic and Microkernel	
	1.3 Linux Kernel, Shell and System Calls	
<b>2</b>	<b>Process and Process Scheduling</b>	<b>9</b>
	2.1 Concept of a Process, Process States, Process Description, Process Control Block.	
	2.2 Uniprocessor Scheduling-Types: Preemptive and Non-preemptive scheduling algorithms (FCFS, SJF, SRTN, Priority, RR)	
	2.3 Threads: Definition and Types, Concept of Multithreading	
<b>3</b>	<b>Process Synchronization and Deadlocks</b>	<b>9</b>
	3.1 Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization.	
	3.2 Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem.	
	3.3 Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery, Dining Philosophers Problem.	
<b>4</b>	<b>Memory Management</b>	<b>9</b>
	4.1 Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB	
	4.2 Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing	
<b>5</b>	<b>File Management</b>	<b>4</b>

	5.1	Overview, File Organization and Access, File Directories, File Sharing	
<b>6</b>		<b>I/O management</b>	<b>4</b>
	6.1	I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK.	

**Textbooks:**

1	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8 <sup>th</sup> Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 9 <sup>th</sup> Edition, 2016, ISBN 978-81-265-5427-0

**References:**

1	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3 <sup>rd</sup> Edition
2	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3 <sup>rd</sup> Edition.
3	Maurice J. Bach, "Design of UNIX Operating System", PHI
4	Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4 <sup>th</sup> Edition

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules

**Useful Links**

1	<a href="https://swayam.gov.in/nd1_noc19_cs50/preview">https://swayam.gov.in/nd1_noc19_cs50/preview</a>
2	<a href="https://nptel.ac.in/courses/117/106/117106113/">https://nptel.ac.in/courses/117/106/117106113/</a>
3	<a href="https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559">https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559</a>

Course Code	Course Name	Credits
CSC405	Microprocessor	3

**Prerequisites: Digital Logic and Computer Architecture**

**Course objectives:**

- |   |  |
|---|--|
| 1 | To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors. |
| 2 | To emphasize on instruction set and logic to build assembly language programs.                                   |
| 3 | To prepare students for higher processor architectures and embedded systems                                      |

**Course outcomes:** On successful completion of course, learner will be able to:

- |   |  |
|---|--|
| 1 | Describe core concepts of 8086 microprocessor.                                     |
| 2 | Interpret the instructions of 8086 and write assembly and Mixed language programs. |
| 3 | Identify the specifications of peripheral chip.                                    |
| 4 | Design 8086 based system using memory and peripheral chips.                        |
| 5 | Appraise the architecture of advanced processors                                   |
| 6 | Understand hyperthreading technology   |

Module	Detailed Contents	Hours
<b>1</b>	<b>The Intel Microprocessors 8086 Architecture</b>	<b>8</b>
	1.1 8086CPU Architecture,	
	1.2 Programmer's Model	
	1.3 Functional Pin Diagram	
	1.4 Memory Segmentation	
	1.5 Banking in 8086	
	1.6 Demultiplexing of Address/Data bus	
	1.7 Functioning of 8086 in Minimum mode and Maximum mode	
	1.8 Timing diagrams for Read and Write operations in minimum and maximum mode	
	1.9 Interrupt structure and its servicing	
<b>2</b>	<b>Instruction Set and Programming</b>	<b>6</b>
	2.1 Addressing Modes	
	2.2 Instruction set-Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions	
	2.3 Assembler Directives and Assembly Language Programming, Macros, Procedures	
<b>3</b>	<b>Memory and Peripherals interfacing</b>	<b>8</b>
	3.1 Memory Interfacing - RAM and ROM Decoding Techniques – Partial and Absolute	
	3.2 8255-PPI-Block diagram, CWR, operating modes, interfacing with 8086.	
	3.3 8257-DMAC-Block diagram, DMA operations and transfer modes.	
	3.4 Programmable Interrupt Controller 8259-Block Diagram, Interfacing the 8259 in single and cascaded mode.	
<b>4</b>	<b>Intel 80386DX Processor</b>	<b>7</b>
	4.1 Architecture of 80386 microprocessor	
	4.2 80386 registers–General purpose Registers, EFLAGS and Control	

		registers	
	<b>4.3</b>	Real mode, Protected mode, virtual 8086 mode	
	<b>4.4</b>	80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism	
<b>5</b>	<b>Pentium Processor</b>		<b>6</b>
	<b>5.1</b>	Pentium Architecture	
	<b>5.2</b>	Superscalar Operation,	
	<b>5.3</b>	Integer & Floating-Point Pipeline Stages,	
	<b>5.4</b>	Branch Prediction Logic,	
	<b>5.5</b>	Cache Organization and	
	<b>5.6</b>	MESI protocol	
<b>6</b>	<b>Pentium 4</b>		<b>4</b>
	<b>6.1</b>	Comparative study of 8086, 80386, Pentium I, Pentium II and Pentium III	
	<b>6.2</b>	Pentium 4: Net burst micro architecture.	
	<b>6.3</b>	Instruction translation look aside buffer and branch prediction	
	<b>6.4</b>	Hyper threading technology and its use in Pentium 4	

### Textbooks:

1	John Uffenbeck, “8086/8088 family: Design Programming and Interfacing”, PHI.
2	Yu-Cheng Liu, Glenn A. Gibson, “Microcomputer System: The 8086/8088 Family, Architecture, Programming and Design”, Prentice Hall
3	Walter A. Triebel, “The 80386DX Microprocessor: hardware, Software and Interfacing”, Prentice Hall
4	Tom Shanley and Don Anderson, “Pentium Processor System Architecture”, Addison-Wesley.
5	K. M. Bhurchandani and A. K. Ray, “Advanced Microprocessors and Peripherals”, McGraw Hill

### References:

1	Barry B. Brey, “Intel Microprocessors”, 8 <sup>th</sup> Edition, Pearson Education India
2	Douglas Hall, “Microprocessor and Interfacing”, Tata McGraw Hill.
3	Intel Manual
4	Peter Abel, “IBM PC Assembly language and Programming”, 5 <sup>th</sup> Edition, PHI
5	James Antonakons, “The Pentium Microprocessor”, Pearson Education

### Assessment:

#### Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### End Semester Theory Examination:

1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

### Useful Links

1	<a href="https://swayam.gov.in/nd1_noc20_ee11/preview">https://swayam.gov.in/nd1_noc20_ee11/preview</a>
2	<a href="https://nptel.ac.in/courses/108/105/108105102/">https://nptel.ac.in/courses/108/105/108105102/</a>
3	<a href="https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894">https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894</a>
4	<a href="https://www.mooc-list.com/tags/microprocessors">https://www.mooc-list.com/tags/microprocessors</a>

Course Name	Lab Name	Credit
CSL401	Analysis of Algorithms Lab	1

**Prerequisite: Basic knowledge of programming and data structure**

**Lab Objectives:**

1	To introduce the methods of designing and analyzing algorithms
2	Design and implement efficient algorithms for a specified application
3	Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem.
4	Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.

**Lab Outcomes:** At the end of the course, the students will be able to

1	Implement the algorithms using different approaches.
2	Analyze the complexities of various algorithms.
3	Compare the complexity of the algorithms for specific problem.

**Description**

Implementation can be in any language.

**Suggested Practical List:**

Sr No		Suggested Experiment List
<b>1</b>		<b>Introduction</b>
	<b>1.1</b>	Selection sort, Insertion sort
<b>2</b>		<b>Divide and Conquer Approach</b>
	<b>2.1</b>	Finding Minimum and Maximum, Merge sort, Quick sort, Binary search
<b>3</b>		<b>Greedy Method Approach</b>
	<b>3.1</b>	Single source shortest path- Dijkstra Fractional Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm
<b>4</b>		<b>Dynamic Programming Approach</b>
	<b>4.1</b>	Single source shortest path- Bellman Ford All pair shortest path- Floyd Warshall 0/1 knapsack Travelling salesperson problem Longest common subsequence
<b>5</b>		<b>Backtracking and Branch and bound</b>
	<b>5.1</b>	N-queen problem Sum of subsets Graph coloring
<b>6</b>		<b>String Matching Algorithms</b>
	<b>6.1</b>	The Naïve string-matching Algorithms The Rabin Karp algorithm The Knuth-Morris-Pratt algorithm



<b>Term Work:</b>	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of “Analysis of Algorithms”
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
<b>Oral &amp; Practical exam</b>	
	Based on the entire syllabus of CSC402: Analysis of Algorithms

Lab Code	Lab Name	Credit
CSL402	Database Management System Lab	1

**Prerequisite:** Discrete Structures

**Lab Objectives:**

1	To explore design and develop of relational model
2	To present SQL and procedural interfaces to SQL comprehensively
3	To introduce the concepts of transactions and transaction processing

**Lab Outcomes:** At the end of the course, the students will be able to

1	Design ER /EER diagram and convert to relational model for the realworld application.
2	Apply DDL, DML, DCL and TCL commands
3	Write simple and complex queries
4	UsePL / SQL Constructs.
5	Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity

**Suggested List of Experiments**

Sr. No.	Title of Experiment
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System
4	Apply DML Commands for the specified system
5	Perform Simple queries, string manipulation operations and aggregate functions.
6	Implement various Join operations.
7	Perform Nested and Complex queries
8	Perform DCL and TCL commands
9	Implement procedure and functions
10	Implementation of Views and Triggers.
11	Demonstrate Database connectivity
12	Implementation and demonstration of Transaction and Concurrency control techniques using locks.

**Term Work:**

1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of “Database Management System”
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

**Oral & Practical exam :** Based on the entire syllabus of CSC403: Database Management System

Course Code	Course Name	Credit
CSL403	Operating System Lab	01

**Prerequisite:** Knowledge on Operating system principles

**Lab Objectives:**

- |   |   |
|---|---|
| 1 | To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment. |
| 2 | To familiarize students with the architecture of Linux OS.  |
| 3 | To provide necessary skills for developing and debugging programs in Linux environment.   |
| 4 | To learn programmatically to implement simple operation system mechanisms   |

**Lab Outcomes:** At the end of the course, the students will be able to

- |   |  |
|---|--|
| 1 | Demonstrate basic Operating system Commands, Shell scripts, System Calls and API wrt Linux |
| 2 | Implement various process scheduling algorithms and evaluate their performance.            |
| 3 | Implement and analyze concepts of synchronization and deadlocks.                           |
| 4 | Implement various Memory Management techniques and evaluate their performance.             |
| 5 | Implement and analyze concepts of virtual memory.  |
| 6 | Demonstrate and analyze concepts of file management and I/O management techniques.         |

**Suggested List of Experiments**

Sr. No.	Content
<b>1</b>	<b>Explore Linux Commands</b>
1.1	<b>Explore usage of basic Linux Commands and system calls for file, directory and process management.</b> For eg: (mkdir, chdir, cat, ls, chown, chmod, chgrp, ps etc. system calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid. sort, grep, awk, etc.)
<b>2</b>	<b>Linux shell script</b>
2.1	Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name. Display current shell, home directory, operating system type, current path setting, current working directory.
<b>3</b>	<b>Linux- API</b>
3.1	Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs.
<b>4</b>	<b>Linux- Process</b>
4.1	a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. b. Explore wait and waitpid before termination of process.
<b>5</b>	<b>Process Management: Scheduling</b>

	5.1	a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms. b. Write a program to demonstrate the concept of preemptive scheduling algorithms
<b>6</b>		<b>Process Management: Synchronization</b>
	6.1	a. Write a C program to implement solution of Producer consumer problem through Semaphore
<b>7</b>		<b>Process Management: Deadlock</b>
	7.1	a. Write a program to demonstrate the concept of deadlock avoidance through Banker's Algorithm b. Write a program demonstrate the concept of Dining Philosopher's Problem
<b>8</b>		<b>Memory Management</b>
	8.1	a. Write a program to demonstrate the concept of MVT and MFT memory management techniques b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.
<b>9</b>		<b>Memory Management: Virtual Memory</b>
	9.1	a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.
<b>10</b>		<b>File Management &amp; I/O Management</b>
	10.1	a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. c. Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN

<b>Term Work:</b>	
1	Term work should consist of 10 experiments covering all modules.
2	Journal must include at least 2 assignments on content of theory and practical of "Database Management System"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
<b>Oral &amp; Practical exam</b>	
	Based on the entire syllabus of CSC405: Operating System.

Lab Code	Lab Name	Credits
CSL404	Microprocessor Lab	1

**Prerequisite:** Basic knowledge digital integrated circuits

**Lab Objectives:**

- |   |   |
|---|---|
| 1 | To emphasize on use of Assembly language program.                       |
| 2 | To prepare students for advanced subjects like embedded system and IOT. |

**Lab Outcomes:** At the end of the course, the students will be able to

- |   |  |
|---|--|
| 1 | Use appropriate instructions to program microprocessor to perform various task |
| 2 | Develop the program in assembly/ mixed language for Intel 8086 processor       |
| 3 | Demonstrate the execution and debugging of assembly/ mixed language program    |

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Use of programming tools (Debug/TASM/MASM/8086kit) to perform basic arithmetic operations on 8-bit/16-bit data
2	Code conversion (Hex to BCD and BCD to Hex)/ (ASCII to BCD and BCD to ASCII)
3	Assembly programming for 16-bit addition, subtraction, multiplication and division (menu based)
4	Assembly program based on string instructions (overlapping/non-overlapping block transfer/ string search/ string length)
5	Assembly program to display the contents of the flag register.
6	Any Mixed Language programs.
7	Assembly program to find the GCD/ LCM of two numbers
8	Assembly program to sort numbers in ascending/ descending order
9	Any program using INT 10H
10	Assembly program to find minimum/ maximum number from a given array.
11	Assembly Program to display a message in different color with blinking
12	Assembly program using procedure.
13	Assembly program using macro.
14	Program and interfacing using 8255.
15	Program and interfacing of ADC/ DAC/ Stepper motor.

**Term Work:**

1	Term work should consist of 10 experiments, out of these at least one experiment on hardware interfacing.
2	Journal must include at least 2 assignments on content of theory and practical of "Microprocessor"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

Lab Code	Lab Name	Credit
CSL405	Skill Base Lab Course: Python Programming	2

**Prerequisite:** Knowledge of some programming language like C, Java

**Lab Objectives:**

1	Basics of Python programming
2	Decision Making, Data structure and Functions in Python
3	Object Oriented Programming using Python
4	Web framework for developing

**Lab Outcomes:** At the end of the course, the students will be able to

1	To understand basic concepts in python.
2	To explore contents of files, directories and text processing with python
3	To develop program for data structure using built in functions in python.
4	To explore django web framework for developing python-based web application.
5	To understand Multithreading concepts using python.

Module		Detailed Content	Hours
<b>1</b>		<b>Python basics</b>	<b>5</b>
	1.1	Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries Exception, Introduction to OOP, Classes, Objects, Interfaces, Inheritance	
<b>2</b>		<b>Advanced Python</b>	<b>4</b>
	2.1	Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.	
<b>3</b>		<b>Data Structure in Python</b>	<b>3</b>
	3.1	Link List, Stack, Queues, Dequeues	
<b>4</b>		<b>Python Integration Primer</b>	<b>4</b>
	4.1	Graphical User interface, Networking in Python, Python database connectivity, Introduction to Django	
<b>5</b>		<b>Multithreading</b>	<b>4</b>
	5.1	Thread and Process, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue	
<b>6</b>		<b>NumPy and Pandas</b>	<b>6</b>
	6.1	Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O	
	6.2	Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames	

**Textbooks:**

1	Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press
2	Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication
3	Anurag Gupta, G. P. Biswas, "Python Programming", McGraw-Hill
4	E. Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Education

**References:**

1	Learn Python the Hard Way, 3 <sup>rd</sup> Edition, Zed Shaw's Hard Way Series
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2	Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication
<b>Digital material:</b>	
1	"The Python Tutorial", <a href="http://docs.python.org/release/3.0.1/tutorial/">http://docs.python.org/release/3.0.1/tutorial/</a>
2	Beginning Perl, <a href="https://www.perl.org/books/beginning-perl/">https://www.perl.org/books/beginning-perl/</a>
3	<a href="http://spoken-tutorial.org">http://spoken-tutorial.org</a>
4	<a href="https://starcertification.org/Certifications/Certificate/python">https://starcertification.org/Certifications/Certificate/python</a>

<b>Suggested experiments using Python:</b>	
<b>Sr. No.</b>	<b>Title of Experiments</b>
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2	Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.
3	Exploring Files and directories a. Python program to append data to existing file and then display the entire file b. Python program to count number of lines, words and characters in a file. c. Python program to display file available in current directory
4	Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
5	Menu driven program for data structure using built in function for link list, stack and queue.
6	Program to demonstrate CRUD ( <b>create, read, update and delete</b> ) operations on database (SQLite/ MySQL) using python.
7	Creation of simple socket for basic information exchange between server and client.
8	Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).
9	Programs on Threading using python.
10	Exploring basics of NumPy Methods.
11	Program to demonstrate use of NumPy: Array objects.
12	Program to demonstrate Data Series and Data Frames using Pandas.
13	Program to send email and read content of URL.

<b>Term Work:</b>	
1	Term work should consist of 12 experiments.
2	Journal must include at least 2 assignments
3	Mini Project based on the content of the syllabus (Group of 2-3 students)
4	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 25 Marks (Journal: 10-marks, Attendance: 05-marks, and Mini Project: 10-marks)

Course code	Course Name	Credits
CSM401	Mini Project B	02

<b>Objectives</b>	
1	To acquaint with the process of identifying the needs and converting it into the problem.
2	To familiarize the process of solving the problem in a group.
3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4	To inculcate the process of self-learning and research.
<b>Outcome:</b> Learner will be able to...	
1	Identify problems based on societal /research needs.
2	Apply Knowledge and skill to solve societal problems in a group.
3	Develop interpersonal skills to work as member of a group or leader.
4	Draw the proper inferences from available results through theoretical/experimental/simulations.
5	Analyze the impact of solutions in societal and environmental context for sustainable development.
6	Use standard norms of engineering practices
7	Excel in written and oral communication.
8	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9	Demonstrate project management principles during project work.
<b>Guidelines for Mini Project</b>	
1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.



<b>Term Work</b>	
The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.	
In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.	
<b>Distribution of Term work marks for both semesters shall be as below:</b>	
	<b>Marks</b>
1	Marks awarded by guide/supervisor based on logbook
2	Marks awarded by review committee
3	Quality of Project report
<b>Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines</b>	
<b>One-year project:</b>	
1	<p>In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.</p> <ul style="list-style-type: none"> <li>• First shall be for finalization of problem</li> <li>• Second shall be on finalization of proposed solution of problem.</li> </ul>
2	<p>In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.</p> <ul style="list-style-type: none"> <li>• First review is based on readiness of building working prototype to be conducted.</li> <li>• Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.</li> </ul>
<b>Half-year project:</b>	
1	<p>In this case in one semester students' group shall complete project in all aspects including,</p> <ul style="list-style-type: none"> <li>• Identification of need/problem</li> <li>• Proposed final solution</li> <li>• Procurement of components/systems</li> <li>• Building prototype and testing</li> </ul>
2	<p>Two reviews will be conducted for continuous assessment,</p> <ul style="list-style-type: none"> <li>• First shall be for finalization of problem and proposed solution</li> <li>• Second shall be for implementation and testing of solution.</li> </ul>
<b>Assessment criteria of Mini Project.</b>	
<b>Mini Project</b> shall be assessed based on following criteria;	
1	Quality of survey/ need identification
2	Clarity of Problem definition based on need.
3	Innovativeness in solutions
4	Feasibility of proposed problem solutions and selection of best solution
5	Cost effectiveness
6	Societal impact
7	Innovativeness

8	Cost effectiveness and Societal impact
9	Full functioning of working model as per stated requirements
10	Effective use of skill sets
11	Effective use of standard engineering norms
12	Contribution of an individual's as member or leader
13	Clarity in written and oral communication
	In <b>one year, project</b> , first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
	In case of <b>half year project</b> all criteria's in generic may be considered for evaluation of performance of students in mini project.
<b>Guidelines for Assessment of Mini Project Practical/Oral Examination:</b>	
1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
<b>Mini Project</b> shall be assessed based on following points;	
1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Full functioning of working model as per stated requirements
5	Effective use of skill sets
6	Effective use of standard engineering norms
7	Contribution of an individual's as member or leader
8	Clarity in written and oral communication

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

### Mechanical Engineering

Third Year (Sem. V & VI) and Final Year (Sem. VII & VIII)

Revised Syllabus (REV- 2012) w. e. f. Academic Year 2014 -  
15 and 2015-2016 respectively

Under

## FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

## **Deans 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**

**Dean,**

**Faculty of Technology,**

**Member - Management Council, Senate, Academic Council**

**University of Mumbai, Mumbai**

## **Chairman Preamble**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the 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 Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives were finalized in a brain storming session, which was attended by more than 20 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To prepare the Learner to use modern tools effectively in order to solve real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organisations and to excel in their Postgraduate studies.
4. To encourage and motivate the Learner in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the above, 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from the point of view of a learner are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stake holders.

**Dr. S. M. Khot**

**Chairman, Board of Studies in Mechanical Engineering, University of Mumbai**

**B. E. Mechanical-(Semester VII)**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract.	Theory	Pract.	Total			
MEC701	Machine Design -II	4	2	4	1	5			
MEC702	CAD/CAM/CAE &	4	2	4	1	5			
MEC703	Mechanical Utility Systems	4	2	4	1	5			
MEC704	Production Planning and Control	4	2	4	1	5			
MEE701X	Elective- I	3	2	3	1	4			
MEP701	Project- I	--	6 <sup>#</sup>	--	3	3			
<b>Total</b>		<b>19</b>	<b>16</b>	<b>19</b>	<b>8</b>	<b>27</b>			
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
MEC701	Machine Design- II	20	20	20	80	03	25	25	150
MEC702	CAD/CAM/CAE <sup>&amp;</sup>	20	20	20	80	03	25	25	150
MEC703	Mechanical Utility Systems	20	20	20	80	03	25	--	125
MEC704	Production Planning and Control	20	20	20	80	03	25	25*	150
MEE701X	Elective -I	20	20	20	80	03	25	--	125
MEP701	Project- I	--	--	--	--	--	50	--	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>75</b>	<b>750</b>

<sup>&</sup> Common with Automobile Engineering      \* Only ORAL examination based on term work and syllabus

**B. E. Mechanical-(Semester VIII)**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract.	Theory	Pract.	Total			
MEC801	Design of Mechanical Systems	4	2	4	1	5			
MEC802	Industrial Engineering and Management	4	2	4	1	5			
MEC803	Refrigeration and Air Conditioning	4	2	4	1	5			
MEE802X	Elective- II	3	2	3	1	4			
MEP802	Project- II	--	12 <sup>#</sup>	--	6	6			
<b>Total</b>		<b>15</b>	<b>20</b>	<b>15</b>	<b>10</b>	<b>25</b>			
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
MEC801	Design of Mechanical Systems	20	20	20	80	03	25	25	150
MEC802	Industrial Engineering and Management	20	20	20	80	03	25	--	125
MEC803	Refrigeration and Air Conditioning	20	20	20	80	03	25	25	150
MEE802X	Elective -II	20	20	20	80	03	25	--	125
MEP802	Project- II	--	--	--	--	--	50	100	150
<b>Total</b>		<b>--</b>	<b>--</b>	<b>80</b>	<b>320</b>	<b>--</b>	<b>150</b>	<b>150</b>	<b>700</b>

\* Only ORAL examination based on term work and syllabus

# indicates work load of Learner (Not faculty) in VII and VIII semester for Project

Project –I and II: Students groups and load of faculty per week

Project Groups: Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load : In semester VII 1/2 hour per week per project group

In semester VIII 1 hour per week per project group

Each faculty is permitted to take (guide) maximum 4 (Four) project groups.

Course codes	Elective I	Course codes	Elective II
MEE7011	Product Life Cycle Management (PLM)	MEE8021	Micro Electro Mechanical Systems (MEMS)
MEE7012	Power Plant Engineering &	MEE8022	Renewable Energy Sources
MEE7013	Energy Management	MEE8023	Project Management &
MEE7014	Supply Chain Management &	MEE8024	Business Process Reengineering
MEE7015	Computational Fluid Dynamics &	MEE8025	Cryogenics
MEE7016	Advanced Turbo Machinery	MEE8026	Automobile Engineering
MEE7017	Piping Engineering	MEE8027	Process Equipment Design
MEE7018	Emission and Pollution Control	MEE8028	Alternative Fuels
MEE7019	Operations Research	MEE8029	Enterprise Resource Planning
MEE70110	Total Productive Maintenance (TPM)	MEE80210	World Class Manufacturing &
MEE70111	Robotics	MEE80211	Nanotechnology
MEE70112	Digital Prototyping for Product Design –I	MEE80212	Digital Prototyping for Product Design –II

& Common with Automobile Engineering

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17  
Under

## FACULTY OF TECHNOLOGY

### **Mechanical Engineering**

**Second Year with Effect from AY 2017-18**

**Third Year with Effect from AY 2018-19**

**Final Year with Effect from AY 2019-20**

As per **Choice Based Credit and Grading System**  
with effect from the AY 2016–17.



**Co-ordinator, Faculty of Technology 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

**Chairman's Preamble:**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the 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 Mechanical Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming sessions, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
4. To prepare the Learner for a successful career in Indian and Multinational Organisations

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Dr. S. M. Khot**

**Chairman, Board of Studies in Mechanical Engineering, University of Mumbai**

**Program Structure for  
B.E. in Mechanical Engineering  
University of Mumbai  
(With Effect from 2017-2018)**

**Semester III**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned						
		Theory	Pract	Theory	Pract	Total				
MEC301	Applied Mathematics III**	04	--	04	--	04				
MEC302	Thermodynamics*	04	--	04	--	04				
MEC303	Strength of Materials*	04	--	04	--	04				
MEC304	Production Process I*	04	--	04	--	04				
MEC305	Material Technology*	03	--	03	--	03				
MEL301	Computer Aided Machine Drawing*	--	2 <sup>s</sup> +4	--	03	03				
MEL302	Strength of Material*	--	02	--	01	01				
MEL303	Material Technology*	--	02	--	01	01				
MEL304	Machine Shop Practice I*	--	04	--	02	02				
<b>Total</b>		<b>19</b>	<b>14</b>	<b>19</b>	<b>07</b>	<b>26</b>				
Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
MEC301	Applied Mathematics III**	20	20	20	80	03	--	--	100	
MEC302	Thermodynamics*	20	20	20	80	03	--	--	100	
MEC303	Strength of Materials*	20	20	20	80	03	--	--	100	
MEC304	Production Process I*	20	20	20	80	03	--	--	100	
MEC305	Material Technology*	20	20	20	80	03	--	--	100	
MEL301	Computer Aided Machine Drawing*	--	--	--	--	--	50	50	100	
MEL302	Strength of Material*	--	--	--	--	--	25	25	50	
MEL303	Material Technology*	--	--	--	--	--	25	--	25	
MEL304	Machine Shop Practice I*	--	--	--	--	--	50	--	50	
<b>Total</b>				<b>100</b>	<b>400</b>		<b>150</b>	<b>75</b>	<b>725</b>	

\* Common with Automobile Engineering

\*\* Common with Automobile Engineering, Production Engineering and Civil Engineering

§ Theory for entire class to be conducted

**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC401	Applied Mathematics IV**	04	--	04	--	04
MEC402	Fluid Mechanics*	04	--	04	--	04
MEC403	Industrial Electronics*	03	--	03	--	03
MEC404	Production Process II*	04	--	04	--	04
MEC405	Kinematics of Machinery*	04	--	04	--	04
MEL401	Data Base and Information Retrieval*	--	2 <sup>s</sup> +2	--	02	02
MEL402	Fluid Mechanics*	--	02	--	01	01
MEL403	Industrial Electronics*	--	02	--	01	01
MEL404	Kinematics of Machinery*	--	02	--	01	01
MEL405	Machine Shop Practice II*	--	04	--	02	02
<b>Total</b>		<b>19</b>	<b>14</b>	<b>19</b>	<b>07</b>	<b>26</b>

Course Code	Course Name	Examination Scheme							Total	
		Theory					Exam Duration (Hrs)	Term Work		Pract/ Oral
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
MEC401	Applied Mathematics IV**	20	20	20	80	03	--	--	100	
MEC402	Fluid Mechanics*	20	20	20	80	03	--	--	100	
MEC403	Industrial Electronics*	20	20	20	80	03	--	--	100	
MEC404	Production Process II*	20	20	20	80	03	--	--	100	
MEC405	Kinematics of Machinery*	20	20	20	80	03	--	--	100	
MEL401	Data Base and Information Retrieval*	--	--	--	--	--	50	50	100	
MEL402	Fluid Mechanics*	--	--	--	--	--	25	25	50	
MEL403	Industrial Electronics*	--	--	--	--	--	25	25	50	
MEL404	Kinematics of Machinery*	--	--	--	--	--	25	--	25	
MEL405	Machine Shop Practice II*	--	--	--	--	--	50	50	100	
<b>Total</b>				<b>100</b>	<b>400</b>		<b>175</b>	<b>150</b>	<b>825</b>	

\* Common with Automobile Engineering

\*\* Common with Automobile Engineering, Production Engineering and Civil Engineering

\$ Theory for entire class to be conducted

**Semester V**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC501	Internal Combustion Engines*	04	--	04	--	04
MEC502	Mechanical Measurements and Control*	04	--	04	--	04
MEC503	Heat Transfer*	04	--	04	--	04
MEC504	Dynamics of Machinery	04	--	04	--	04
<b>MEDLO 501X</b>	<b>Department Level Optional Course I</b>	<b>04</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>04</b>
MEL501	Internal Combustion Engines	--	02	--	01	01
MEL502	Mechanical Measurements and Control	--	02	--	01	01
MEL503	Heat Transfer	--	02	--	01	01
MEL504	Dynamics of Machinery	--	02	--	01	01
MEL505	Manufacturing Sciences Lab	--	02	--	01	01
MEL506	Business Communication and Ethics	--	02 <sup>§</sup> +02	--	02	02
<b>Total</b>		<b>20</b>	<b>14</b>	<b>20</b>	<b>07</b>	<b>27</b>

Course Code	Course Name	Examination Scheme							Term Work	Pract/ Oral	Total
		Theory			End Sem Exam	Exam Duration (Hrs)					
		Internal Assessment									
		Test1	Test 2	Avg							
MEC501	Internal Combustion Engines	20	20	20	80	03	--	--	100		
MEC502	Mechanical Measurements and Control	20	20	20	80	03	--	--	100		
MEC503	Heat Transfer	20	20	20	80	03	--	--	100		
MEC504	Dynamics of Machinery	20	20	20	80	03	--	--	100		
<b>MEDLO 501X</b>	<b>Department Level Optional Course I</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>100</b>		
MEL501	Internal Combustion Engines	--	--	--	--	--	25	25	50		
MEL502	Mechanical Measurements and Control	--	--	--	--	--	25	25	50		
MEL503	Heat Transfer	--	--	--	--	--	25	25	50		
MEL504	Dynamics of Machinery	--	--	--	--	--	25	25	50		
MEL505	Manufacturing Sciences Lab	--	--	--	--	--	25	--	25		
MEL506	Business Communication and Ethics	--	--	--	--	--	50	--	50		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>175</b>	<b>100</b>	<b>775</b>		

<sup>§</sup>Theory classes shall be conducted for entire class

Course Code	Department Level Elective Course I
MEDLO5011	Press Tool Design
MEDLO5012	Machining Sciences and Tool Design
MEDLO5013	Design of Jigs and Fixtures

**Semester VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC601	Metrology and Quality engineering	04	--	04	--	04
MEC602	Machine Design I	04	--	04	--	04
MEC603	Finite Element analysis	04	--	04	--	04
MEC604	Refrigeration and Air Conditioning	04	--	04	--	04
<b>MEDLO602X</b>	<b>Department Level Optional Course II</b>	<b>04</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>04</b>
<b>MEL601</b>	<b>Metrology and Quality Engineering</b>	<b>--</b>	<b>02</b>	<b>--</b>	<b>01</b>	<b>01</b>
<b>MEL602</b>	<b>Machine Design I</b>	<b>--</b>	<b>02</b>	<b>--</b>	<b>01</b>	<b>01</b>
<b>MEL603</b>	<b>Finite Element Analysis</b>	<b>--</b>	<b>02</b>	<b>--</b>	<b>01</b>	<b>01</b>
<b>MEL604</b>	<b>Refrigeration and Air Conditioning</b>	<b>--</b>	<b>02</b>	<b>--</b>	<b>01</b>	<b>01</b>
<b>MEL605</b>	<b>Mechatronics Lab</b>	<b>--</b>	<b>02</b>	<b>--</b>	<b>01</b>	<b>01</b>
<b>Total</b>		<b>20</b>	<b>10</b>	<b>20</b>	<b>05</b>	<b>25</b>

Course Code	Course Name	Examination Scheme							Total
		Theory			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	
		Internal Assessment							
		Test1	Test 2	Avg					
MEC601	Metrology and Quality engineering	20	20	20	80	03	--	--	100
MEC602	Machine Design I	20	20	20	80	03	--	--	100
MEC603	Finite Element Analysis	20	20	20	80	03	--	--	100
MEC604	Refrigeration and Air Conditioning	20	20	20	80	03	--	--	100
<b>MEDLO602X</b>	<b>Department Level Optional Course II</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>100</b>
<b>MEL601</b>	<b>Metrology and Quality engineering</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	<b>25</b>	<b>50</b>
<b>MEL602</b>	<b>Machine Design I</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	<b>--</b>	<b>25</b>
<b>MEL603</b>	<b>Finite Element analysis</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	<b>25</b>	<b>50</b>
<b>MEL604</b>	<b>Refrigeration and Air Conditioning</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	<b>25</b>	<b>50</b>
<b>MEL605</b>	<b>Mechatronics Lab</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	<b>25</b>	<b>50</b>
<b>Total</b>				<b>100</b>	<b>400</b>		<b>125</b>	<b>100</b>	<b>725</b>

Course Code	Department Level Optional Course II
<b>MEDLO6021</b>	<b>Mechatronics</b>
<b>MEDLO6022</b>	<b>Robotics</b>
<b>MEDLO6023</b>	<b>Industrial Automation</b>

**Semester VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC701	Machine Design II	04	--	04	--	04
MEC702	CAD/CAM/CAE	04	--	04	--	04
MEC703	Production Planning and Control	04	--	04	--	04
<b>MEDLO703X</b>	<b>Department Level Optional Course III</b>	<b>04</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>04</b>
<b>ILO701X</b>	<b>Institute Level Optional Course I<sup>#</sup></b>	<b>03</b>	<b>--</b>	<b>03</b>	<b>--</b>	<b>03</b>
MEL701	Machine Design II	--	02	--	01	01
MEL702	CAD/CAM/CAE	--	02	--	01	01
MEL703	Production Planning and Control	--	02	--	01	01
MEL704	Project I	--	06	--	03	03
<b>Total</b>		<b>19</b>	<b>12</b>	<b>19</b>	<b>06</b>	<b>25</b>

Course Code	Course Name	Examination Scheme							Total		
		Theory					End Sem Exam	Exam Duration (Hrs)		Term Work	Pract/ Oral
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
MEC701	Machine Design II	20	20	20	80	03	--	--	100		
MEC702	CAD/CAM/CAE	20	20	20	80	03	--	--	100		
MEC703	Production Planning and Control	20	20	20	80	03	--	--	100		
<b>MEDLO703X</b>	<b>Department Level Optional Course III</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>100</b>		
<b>ILO701X</b>	<b>Institute Level Optional Course I<sup>#</sup></b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>--</b>	<b>--</b>	<b>100</b>		
MEL701	Machine Design II	--	--	--	--	--	25	25	50		
MEL702	CAD/CAM/CAE	--	--	--	--	--	25	25	50		
MEL703	Production Planning and Control	--	--	--	--	--	25	25	50		
MEP701	Project I	--	--	--	--	--	50	--	50		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>125</b>	<b>75</b>	<b>700</b>		

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I <sup>#</sup>
MEDLO7031	Mechanical Vibrations	ILO7011	Product Lifecycle Management
MEDLO7032	Automobile Engineering	ILO7012	Reliability Engineering
MEDLO7033	Pumps, Compressors and Fans	ILO7013	Management Information System
MEDLO7034	Computational Fluid Dynamics	ILO7014	Design of Experiments
		ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

# Common with all branches

**Semester VIII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC801	Design of Mechanical Systems	04	--	04	--	04
MEC802	Industrial Engineering and Management	04	--	04	--	04
MEC803	Power Engineering	04	--	04	--	04
MEDLO804X	Department Level Optional Course IV	04	--	04	--	04
ILO802X	Institute Level Optional Course II <sup>#</sup>	03	--	03	--	03
MEL801	Design of Mechanical Systems	--	02	--	01	01
MEL802	Power Engineering	--	02	--	01	01
MEP801	Project II	--	12	--	06	06
<b>Total</b>		<b>19</b>	<b>16</b>	<b>19</b>	<b>08</b>	<b>27</b>

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
MEC801	Design of Mechanical Systems	20	20	20	80	03	--	--	100		
MEC802	Industrial Engineering and Management	20	20	20	80	03	--	--	100		
MEC803	Power Engineering	20	20	20	80	03	--	--	100		
MEDLO804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100		
ILO802X	Institute Level Optional Course II <sup>#</sup>	20	20	20	80	03	--	--	100		
MEL801	Design of Mechanical Systems	--	--	--	--	--	25	25	50		
MEL802	Power Engineering	--	--	--	--	--	25	25	50		
MEL803	Project II	--	--	--	--	--	50	100	150		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>100</b>	<b>150</b>	<b>750</b>		

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II <sup>#</sup>
MEDLO8041	Power Plant Engineering	ILO8021	Project Management
MEDLO8042	Rapid Prototyping	ILO8022	Finance Management
MEDLO8043	Renewable Energy Systems	ILO8023	Entrepreneurship Development and Management
MEDLO8044	Energy Management in Utility Systems	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

# Common with all branches



# UNIVERSITY OF MUMBAI



## **Bachelor of Engineering**

in

## **Mechanical 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)

AC 23/07/2020Item No. 119

### Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year B.E. in Mechanical Engineering</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<del>P.G. / U.G./Diploma / Certificate</del> (Strike out which is not applicable)
7	Pattern	<del>Yearly / Semester</del> (Strike out which is not applicable )
8	Status	<del>New / Revised</del> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>From Academic Year: 2020-2021</b>

Date

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

University of Mumbai

University of Mumbai

Dr Anuradha Muzumdar

Dean

Faculty of Science and Technology

University of Mumbai

B. E. (Mechanical Engineering), Rev 2019 2

## 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 171, 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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## Preface

When the entire world is discussing about ‘Industry 4.0’, we are at the crossroads. There are so many expectations from the graduating engineers, who shall be the major contributors to ecosystem for development of the Nation. Engineering education in India, in general, is being revamped so as to impart the theoretical knowledge along with industrial exposure. It is our attempt, when we are introducing a new curriculum; to bridge the industry-academia gap. To enable this, we have introduced components such as skill-based laboratories and project-based learning. We trust that this will allow the learner to apply knowledge gained in previous and current semesters to solve problems for gaining better understanding. What once were pure mechanical systems have now been transformed into multidisciplinary systems of mechatronics, electronics and computer science. Interdisciplinary knowledge is gaining importance as we are moving towards automated world as technology advances. Keeping this in mind the curriculum has been designed in a way so that learner shall be acquainted with many Interdisciplinary subjects.

Engineers develop new technological solutions. During the engineering design process, the responsibilities of the engineer may include defining problems, conducting and narrowing research, analyzing criteria, finding and analyzing solutions, and making decisions. The Program Educational Objectives for Undergraduate Program were finalized in a brain storming session, which was attended by several faculty members and Industry experts. The Program Educational Objectives proposed for the undergraduate program in Mechanical Engineering are listed below:

1. To prepare the stake holder to exhibit leadership qualities with demonstrable attributes in lifelong learning to contribute to the societal needs.
2. To make ready the stake holder to pursue higher education for professional development
3. To help the stake holder to acquire the analytical and technical skills, knowledge, analytical ability attitude and behavior through the program
4. To prepare the stakeholders with a sound foundation in the mathematical, scientific and engineering fundamentals
5. To motivate the learner in the art of self-learning and to use modern tools for solving real life problems and also inculcate a professional and ethical attitude and good leadership qualities
6. To prepare the stake holder to able to Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

We trust this revised version of syllabus come up to the expectations of all stakeholders. We trust this revised version of syllabus come up to the expectations of all stakeholders. We wish to place on record our sincere thanks and appreciations to the various contributors from the academia and industry for their most learned inputs in framing this syllabus.

### **Board of Studies in Mechanical Engineering**

Dr. Vivek K. Sunnapwar	: Chairman
Dr. S. M. Khot	: Member
Dr. V. M. Phalle	: Member
Dr. Siddappa Bhusnoor	: Member
Dr. S.S. Pawar	: Member
Dr. Sanjay U. Bokade	: Member
Dr. Dhanraj Tambuskar	: 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
MEC301	Engineering Mathematics-III	3	--	1	3	--	1	4
MEC302	Strength of Materials	3		--	3		--	3
MEC303	Production Processes	4	--	--	4	--	--	4
MEC304	Materials and Metallurgy	3	--	--	3	--	--	3
MEC305	Thermodynamics	3	--	--	3	--	--	3
MEL301	Materials Testing	--	2	--	--	1	--	1
MEL302	Machine Shop Practice	--	4	--	--	2	--	2
MESBL301	CAD – Modeling	--	4	--	--	2	--	2
MEPBL301	Mini Project – 1A	--	4 <sup>s</sup>	--	--	2	--	2
<b>Total</b>		<b>16</b>	<b>14</b>	<b>1</b>	<b>16</b>	<b>07</b>	<b>1</b>	<b>24</b>

Course Code	Course Name	Examination Scheme							Total
		Theory					Term Work	Pract/ Oral	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg .					
MEC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
MEC302	Strength of Materials	20	20	20	80	3	--	--	100
MEC303	Production Processes	20	20	20	80	3	--	--	100
MEC304	Materials and Metallurgy	20	20	20	80	3	--	--	100
MEC305	Thermodynamics	20	20	20	80	3	--	--	100
MEL301	Materials Testing	--	--	--	--	--	25	25	50
MEL302	Machine Shop Practice	--	--	--	--	--	50	--	50
MESBL301	CAD – Modeling	--	--	--	--	--	25	25	50
MEPBL301	Mini Project – 1A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>	<b>75</b>	<b>725</b>

\$ indicates work load of Learner (Not Faculty), for Mini Project

SBL – Skill Based Laboratory

PBL – Project Based Learning

### Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC401	Engineering Mathematics-IV	3	--	1	3	--	1	4
MEC402	Fluid Mechanics	3	--	--	3	--	--	3
MEC403	Kinematics of Machinery	3	--	--	3	--	--	3
MEC404	CAD/CAM	3	--	--	3	--	--	3
MEC405	Industrial Electronics	3	--	--	3	--	--	3
MEL401	Industrial Electronics	--	2	--	--	1	--	1
MEL402	Kinematics of Machinery	--	2	--	--	1	--	1
MEL403	Python Programming	--	2	--	--	1	--	1
MESBL401	CNC and 3-D Printing	--	4	--	--	2	--	2
MEPBL401	Mini Project – 1B	--	4 <sup>\$</sup>	--	--	2	--	2
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>23</b>

Course Code	Course Name	Examination Scheme							Total		
		Theory					End Sem. Exam	Exam. Duration (in Hrs)		Term Work	Pract/ Oral
		Internal Assessment			Avg.						
		Test1	Test 2	Avg.							
MEC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125		
MEC402	Fluid Mechanics	20	20	20	80	3	--	--	100		
MEC403	Kinematics of Machinery	20	20	20	80	3	--	--	100		
MEC404	CAD/CAM	20	20	20	80	3	--	--	100		
MEC405	Industrial Electronics	20	20	20	80	3	--	--	100		
MEL401	Industrial Electronics	--	--	--	--	--	25	25	50		
MEL402	Kinematics of Machinery	--	--	--	--	--	25	--	25		
MEL403	Python Programming	--	--	--	--	--	25	25	50		
MESBL401	CNC and 3-D Printing	--	--	--	--	--	25	25	50		
MEPBL401	Mini Project – 1B	--	--	--	--	--	25	25	50		
<b>Total</b>		--	--	<b>100</b>	<b>400</b>	--	<b>150</b>	<b>100</b>	<b>750</b>		

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SBL – Skill Based Laboratory

PBL – Project Based Learning

**Students group and load of faculty per week.**

**Mini Project 1A / 1B:** Students can form groups with minimum 2 (Two) members and not more than 4 (Four) members

**Faculty Load:** 1 hour per week per four groups

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Mechanical Engineering

Third Year with Effect from AY 2021-22

(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)





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Date

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Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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.

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Dr. S.S. Pawar	: Member
Dr. Sanjay U. Bokade	: Member
Dr. Dhanraj Tambuskar	: Member

**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
MEC501	Mechanical Measurements and Controls	3	--	3	--	3
MEC502	Thermal Engineering	3	--	3	--	3
MEC503	Dynamics of Machinery	3	--	3	--	3
MEC504	Finite Element Analysis	3	--	3	--	3
MEDLO501X	Department Level Optional Course – 1	3	--	3	--	3
MEL501	Thermal Engineering	--	2	--	1	1
MEL502	Dynamics of Machinery	--	2	--	1	1
MEL503	Finite Element Analysis	--	2	--	1	1
MESBL501	Professional Communication and Ethics –II	--	2*+2	--	2	2
MEPBL501	Mini Project – 2 A	--	4 <sup>\$</sup>	--	2	2
<b>Total</b>		<b>15</b>	<b>14</b>	<b>15</b>	<b>07</b>	<b>22</b>

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/ Oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
MEC501	Mechanical Measurements and Controls	20	20	20	80	3	--	--	100
MEC502	Thermal Engineering	20	20	20	80	3	--	--	100
MEC503	Dynamics of Machinery	20	20	20	80	3	--	--	100
MEC504	Finite Element Analysis	20	20	20	80	3	--	--	100
MEDLO501X	Department Level Optional Course – 1	20	20	20	80	3	--	--	100
MEL501	Thermal Engineering	--	--	--	--	--	25	--	25
MEL502	Dynamics of Machinery	--	--	--	--	--	25	25	50
MEL503	Finite Element Analysis	--	--	--	--	--	25	25	50
MESBL501	Professional Communication and Ethics - II	--	--	--	--	--	25	25	50
MEPBL501	Mini Project – 2 A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>125</b>	<b>100</b>	<b>725</b>

\* Theory class to be conducted for full class, \$ indicates work load of Learner (Not Faculty), for Mini Project;

SBL – Skill Based Laboratory  
PBL – Project Based Learning

**Department Level Optional Course – 1**

<b>Course Code</b>	<b>Department Level Optional Course – 1</b>
MEDLO5011	Optimization Techniques
MEDLO5012	Statistical Techniques
MEDLO5013	Computational Methods

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# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

### Automobile Engineering

Third Year (Sem. V & VI) and Final Year (Sem. VII & VIII)

Revised Syllabus (REV- 2012) w.e.f. Academic Year 2014 -  
15 and 2015-2016 respectively

Under

## FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

## **Deans 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**  
**Dean,**  
**Faculty of Technology,**  
**Member - Management Council, Senate, Academic Council**  
**University of Mumbai, Mumbai**



## **Chairman Preamble**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the 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 Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives were finalized in a brain storming session, which was attended by more than 20 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To prepare the Learner to use modern tools effectively in order to solve real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organisations and to excel in their Postgraduate studies.
4. To encourage and motivate the Learner in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the above, 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from the point of view of a learner are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stake holders.

**Dr. S. M. Khot**

**Chairman, Board of Studies in Mechanical Engineering, University of Mumbai**

### B. E. Automobile-(Semester VII)

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
AEC701	Chassis Body Engineering	3	2	3	1	4
AEC702	CAD/CAM/CAE <sup>&amp;</sup>	4	2	4	1	5
AEC703	Automotive Design	4	2	4	1	5
AEC704	Product Design and Development	4	2	4	1	5
AEE701X	Elective I	3	2	3	1	4
AEP701	Project I	--	6 <sup>#</sup>	--	3	3
<b>Total</b>		<b>18</b>	<b>16</b>	<b>18</b>	<b>8</b>	<b>26</b>

  

Course Code	Course Name	Examination Scheme							Total
		Theory					Term Work	Pract./oral	
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.					
AEC701	Chassis Body Engineering	20	20	20	80	03	25	25	150
AEC702	CAD/CAM/CAE <sup>&amp;</sup>	20	20	20	80	03	25	25	150
AEC703	Automotive Design	20	20	20	80	03	25	25*	150
AEC704	Product Design and Development	20	20	20	80	03	25	--	125
AEE701X	Elective I	20	20	20	80	03	25	--	125
AEP701	Project I	--	--	--	--	--	50	--	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>75</b>	<b>750</b>

<sup>&</sup> Common with Mechanical Engineering      \* Only ORAL examination based on term work and syllabus

### B. E. Automobile-(Semester VIII)

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
AEC801	Autotronics	4	2	4	1	5
AEC802	Vehicle Dynamics	4	2	4	1	5
AEC803	Vehicle Maintenance	4	2	4	1	5
AEE802X	Elective II	3	2	3	1	4
AEP802	Project II	--	12 <sup>#</sup>	--	6	6
<b>Total</b>		<b>15</b>	<b>20</b>	<b>15</b>	<b>10</b>	<b>25</b>

  

Course Code	Course Name	Examination Scheme							Total
		Theory					Term Work	Pract./oral	
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
AEC801	Autotronics	20	20	20	80	03	25	25	150
AEC802	Vehicle Dynamics	20	20	20	80	03	25	--	125
AEC803	Vehicle Maintenance	20	20	20	80	03	25	25	150
AEE802X	Elective II	20	20	20	80	03	25	--	125
AEP802	Project II	--	--	--	--	--	50	100	150
<b>Total</b>		<b>--</b>	<b>--</b>	<b>80</b>	<b>320</b>	<b>--</b>	<b>150</b>	<b>150</b>	<b>700</b>

\* Only ORAL examination based on term work and syllabus

# indicates work load of Learner (Not faculty) in VII and VIII semester for Project

Project –I and II: Students groups and load of faculty per week

Project Groups : Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load: In semester VII – ½ an hour per week per project group

In semester VIII - 1 hour per week per project group

**Each faculty is permitted to take (guide) maximum 4 (Four) project groups.**

<b>Course Code</b>	<b>Elective I</b>	<b>Course Code</b>	<b>Elective II</b>
AEE7011	Power Plant Engineering &	AEE8021	Noise Vibrations & Harshness
AEE7012	Supply Chain Management &	AEE8022	Vehicle Safety
AEE7013	Tribology	AEE8023	World Class Manufacturing &
AEE7014	Computational Fluid Dynamics &	AEE8024	Knowledge Management
AEE7015	Automotive Embedded Systems	AEE8025	Project Management &
AEE7016	Industrial Robotics	AEE8026	Artificial Intelligence
AEE7017	Transportation Management Motor Industry	AEE8027	Virtual Reality

**& Common with Mechanical Engineering**

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17  
Under

## FACULTY OF TECHNOLOGY

### **Automobile Engineering**

**Second Year with Effect from AY 2017-18**

**Third Year with Effect from AY 2018-19**

**Final Year with Effect from AY 2019-20**

As per **Choice Based Credit and Grading System**  
with effect from the AY 2016–17

**Co-ordinator, Faculty of Technology's 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

**Chairman's Preamble:**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the 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 Mechanical Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming sessions, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
4. To prepare the Learner for a successful career in Indian and Multinational Organisations

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Dr. S. M. Khot**

**Chairman, Board of Studies in Mechanical Engineering, University of Mumbai**

**Program Structure for  
B.E.in Automobile Engineering  
University of Mumbai  
(With Effect from 2017-2018)**

**Semester III**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned						
		Theory	Pract	Theory	Pract	Total				
AEC301	Applied Mathematics III**	04	--	04	--	04				
AEC302	Thermodynamics*	04	--	04	--	04				
AEC303	Strength of Materials*	04	--	04	--	04				
AEC304	Production Process I*	04	--	04	--	04				
AEC305	Material Technology*	03	--	03	--	03				
AEL301	Computer Aided Machine Drawing*	--	2 <sup>s</sup> +4	--	03	03				
AEL302	Strength of Material*	--	02	--	01	01				
AEL303	Material Technology*	--	02	--	01	01				
AEL304	Machineshop Practice I*	--	04	--	02	02				
<b>Total</b>		<b>19</b>	<b>14</b>	<b>19</b>	<b>07</b>	<b>26</b>				
Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
AEC301	Applied Mathematics III**	20	20	20	80	03	--	--	100	
AEC302	Thermodynamics*	20	20	20	80	03	--	--	100	
AEC303	Strength of Materials*	20	20	20	80	03	--	--	100	
AEC304	Production Process I*	20	20	20	80	03	--	--	100	
AEC305	Material Technology*	20	20	20	80	03	--	--	100	
AEL301	Computer Aided Machine Drawing*	--	--	--	--	--	50	50	100	
AEL302	Strength of Material*	--	--	--	--	--	25	25	50	
AEL303	Material Technology*	--	--	--	--	--	25	--	25	
AEL304	Machineshop Practice I*	--	--	--	--	--	50	--	50	
<b>Total</b>				<b>100</b>	<b>400</b>		<b>150</b>	<b>75</b>	<b>725</b>	

\*Common with Automobile Engineering

\*\*Common with Automobile Engineering, Production Engineering and Civil Engineering

\$Theory for entire class to be conducted

**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
AEC401	Applied Mathematics IV**	04	--	04	--	04
AEC402	Fluid Mechanics*	04	--	04	--	04
AEC403	Industrial Electronics*	03	--	03	--	03
AEC404	Production Process II*	04	--	04	--	04
AEC405	Kinematics of Machinery*	04	--	04	--	04
AEL401	Data Base and Information Retrieval*	--	2 <sup>s</sup> +2	--	02	02
AEL402	Fluid Mechanics*	--	02	--	01	01
AEL403	Industrial Electronics*	--	02	--	01	01
AEL404	Kinematics of Machinery*	--	02	--	01	01
AEL405	Machine Shop Practice II*	--	04	--	02	02
<b>Total</b>		<b>19</b>	<b>14</b>	<b>19</b>	<b>07</b>	<b>26</b>

Course Code	Course Name	Examination Scheme							Total		
		Theory					End Sem Exam	Exam Duration (Hrs)		Term Work	Pract/ Oral
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
AEC401	Applied Mathematics IV**	20	20	20	80	03	--	--	100		
AEC402	Fluid Mechanics*	20	20	20	80	03	--	--	100		
AEC403	Industrial Electronics*	20	20	20	80	03	--	--	100		
AEC404	Production Process II*	20	20	20	80	03	--	--	100		
AEC405	Kinematics of Machinery*	20	20	20	80	03	--	--	100		
AEL401	Data Base and Information Retrieval*	--	--	--	--	--	50	50	100		
AEL402	Fluid Mechanics*	--	--	--	--	--	25	25	50		
AEL403	Industrial Electronics*	--	--	--	--	--	25	--	25		
AEL404	Kinematics of Machinery*	--	--	--	--	--	25	--	25		
AEL405	Machine Shop Practice II*	--	--	--	--	--	50	50	100		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>175</b>	<b>150</b>	<b>825</b>		

\*Common with Automobile Engineering

\*\*Common with Automobile Engineering, Production Engineering and Civil Engineering

\$Theory for entire class to be conducted



**Semester V**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
AEC501	Internal Combustion Engines*	04	--	04	--	04
AEC502	Mechanical Measurements and Control*	04	--	04	--	04
AEC503	Heat Transfer*	04	--	04	--	04
AEC504	Automotive Systems	03	--	03	--	03
AEDLO 501X	Department Level Optional Course I	04	--	04	--	04
AEL501	Internal Combustion Engines*	--	02	--	01	01
AEL502	Mechanical Measurements and Control*	--	02	--	01	01
AEL503	Heat Transfer*	--	02	--	01	01
AEL504	Automotive Systems	--	02	--	01	01
AEL505	Manufacturing Sciences Lab*	--	02	--	01	01
AEL506	Business Communication and Ethics*	--	2 <sup>s</sup> +2	--	02	02
<b>Total</b>		<b>19</b>	<b>14</b>	<b>19</b>	<b>07</b>	<b>26</b>

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
AEC501	Internal Combustion Engines*	20	20	20	80	03	--	--	100		
AEC502	Mechanical Measurements and Control*	20	20	20	80	03	--	--	100		
AEC503	Heat Transfer*	20	20	20	80	03	--	--	100		
AEC504	Automotive Systems	20	20	20	80	03	--	--	100		
AEDLO 501X	Department Level Optional Course I*	20	20	20	80	03	--	--	100		
AEL501	Internal Combustion Engines*	--	--	--	--	--	25	25	50		
AEL502	Mechanical Measurements and Control*	--	--	--	--	--	25	25	50		
AEL503	Heat Transfer*	--	--	--	--	--	25	25	50		
AEL504	Automotive Systems	--	--	--	--	--	25	25	50		
AEL505	Manufacturing Sciences Lab*	--	--	--	--	--	25	--	25		
AEL506	Business Communication and Ethics*	--	--	--	--	--	50	--	50		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>175</b>	<b>100</b>	<b>775</b>		

Course Code	Department Level Elective Course I
AEDLO5011	Press Tool Design*
AEDLO5012	Machining Sciences and Tool Design*
AEDLO5013	Design of Jigs and Fixtures*

\*Common with Mechanical Engineering

\$ Theory for entire class to be conducted

**Semester VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
AEC601	Chassis and Body Engineering	04	--	04	--	04
AEC602	Machine Design I*	04	--	04	--	04
AEC603	Finite Element Analysis*	04	--	04	--	04
AEC604	Mechanical Vibrations	04	--	04	--	04
AEDLO602X	Department Level Optional Course II	04	--	04	--	04
AEL601	Chassis and Body Engineering	--	02	--	01	01
AEL602	Machine Design I*	--	02	--	01	01
AEL603	Finite Element Analysis*	--	02	--	01	01
AEL604	Mechanical Vibrations	--	02	--	01	01
AEL605	Mechatronics Lab	--	02	--	01	01
<b>Total</b>		<b>20</b>	<b>10</b>	<b>20</b>	<b>05</b>	<b>25</b>

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
AEC601	Chassis and Body Engineering	20	20	20	80	03	--	--	100		
AEC602	Machine Design I*	20	20	20	80	03	--	--	100		
AEC603	Finite Element Analysis*	20	20	20	80	03	--	--	100		
AEC604	Mechanical Vibrations	20	20	20	80	03	--	--	100		
AEDLO602X	Department Level Optional Course II	20	20	20	80	03	--	--	100		
AEL601	Chassis and Body Engineering	--	--	--	--	--	25	25	50		
AEL602	Machine Design I*	--	--	--	--	--	25	--	25		
AEL603	Finite Element Analysis*	--	--	--	--	--	25	25	50		
AEL604	Mechanical Vibrations	--	--	--	--	--	25	25	50		
AEL605	Mechatronics Lab	--	--	--	--	--	25	25	50		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>125</b>	<b>100</b>	<b>725</b>		

Course Code	Department Level Optional Course II
AEDLO6021	Mechatronics
AEDLO6022	Robotics
AEDLO6023	Automotive Materials

**\*Common with Mechanical Engineering**

**Semester VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
AEC701	Automotive Design	04	--	04	--	04
AEC702	CAD/CAM/CAE*	04	--	04	--	04
AEC703	Autotronics	04	--	04	--	04
AEDLO703X	Department Level Optional Course III	04	--	04	--	04
ILO701X	Institute Level Optional Course I <sup>#</sup>	03	--	03	--	03
AEL701	Automotive Design	--	02	--	01	01
AEL702	CAD/CAM/CAE*	--	02	--	01	01
AEL703	Autotronics	--	02	--	01	01
AEP701	Project I	--	06	--	03	03
<b>Total</b>		<b>19</b>	<b>12</b>	<b>19</b>	<b>06</b>	<b>25</b>

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
AEC701	Automotive Design	20	20	20	80	03	--	--	100		
AEC702	CAD/CAM/CAE*	20	20	20	80	03	--	--	100		
AEC703	Autotronics	20	20	20	80	03	--	--	100		
AEDLO703X	Department Level Optional Course III	20	20	20	80	03	--	--	100		
ILO701X	Institute Level Optional Course I <sup>#</sup>	20	20	20	80	03	--	--	100		
AEL701	Automotive Design	--	--	--	--	--	25	25	50		
AEL702	CAD/CAM/CAE*	--	--	--	--	--	25	25	50		
AEL703	Autotronics	--	--	--	--	--	25	25	50		
AEP701	Project I	--	--	--	--	--	50	--	50		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>125</b>	<b>75</b>	<b>700</b>		

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I <sup>#</sup>
AEDLO7031	Automotive NVH	ILO7011	Product Lifecycle Management
AEDLO7032	Automotive Embedded Systems	ILO7012	Reliability Engineering
AEDLO7033	Automotive Aerodynamics and Aesthetics	ILO7013	Management Information System
AEDLO7034	Computational Fluid Dynamics*	ILO7014	Design of Experiments
		ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

\*Common with Mechanical Engineering

# Common with all branches

**Semester VIII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
AEC801	Vehicle Maintenance	03	--	03	--	03
AEC802	Vehicle Dynamics	04	--	04	--	04
AEC803	Vehicle Safety	03	--	03	--	03
AEDLO 804X	Department Level Optional Course IV	04	--	04	--	04
ILO802X	Institute Level Optional Course II <sup>#</sup>	03	--	03	--	03
AEL801	Automotive Workshop	--	04	--	02	02
AEL802	Vehicle Dynamics	--	02	--	01	01
AEP801	Project II	--	12	--	06	06
<b>Total</b>		<b>17</b>	<b>18</b>	<b>17</b>	<b>09</b>	<b>26</b>

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
AEC801	Vehicle Maintenance	20	20	20	80	03	--	--	100		
AEC802	Vehicle Dynamics	20	20	20	80	03	--	--	100		
AEC803	Vehicle Safety	20	20	20	80	03	--	--	100		
AEDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100		
ILO802X	Institute Level Optional Course II <sup>#</sup>	20	20	20	80	03	--	--	100		
AEL801	Automotive Workshop	--	--	--	--	--	25	25	50		
AEL802	Vehicle Dynamics	--	--	--	--	--	25	25	50		
AEP801	Project II	--	--	--	--	--	50	100	150		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>100</b>	<b>150</b>	<b>750</b>		

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II <sup>#</sup>
AEDLO8041	Hybrid Electric and Fuel cell Vehicles	ILO8021	Project Management
AEDLO8042	Rapid Prototyping*	ILO8022	Finance Management
AEDLO8043	Product Design and Development	ILO8023	Entrepreneurship Development and Management
AEDLO8044	Transport Management and Motor Industry	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

\*Common with Mechanical Engineering

# Common with all branches

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Automobile 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)

AC 23/07/2020

Item No. 118



### Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year B.E. in Automobile Engineering</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./-Diploma / Certificate</b> (Strike out which is not applicable)
7	Pattern	<b>Yearly / Semester</b> (Strike out which is not applicable )
8	Status	<b>New / Revised</b> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>From Academic Year: 2020-2021</b>

Date

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and  
Technology University of Mumbai

## 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 171, 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

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and

## **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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and  
TechnologyUniversity of Mumbai



## Preface

Engineering education in India, in general, is being revamped so as to impart the theoretical knowledge along with industrial exposure. It is our attempt, when we are introducing a new curriculum; to bridge the industry-academia gap. To enable this, we have introduced components such as skill-based laboratories and project-based learning. We trust that this will allow the learner to apply knowledge gained in previous and current semesters to solve problems for gaining better understanding. What once were pure mechanical systems have now been transformed into multidisciplinary systems of mechatronics, electronics and computer science. Interdisciplinary knowledge is gaining importance as we are moving towards automated world as technology advances. Keeping this in mind the curriculum has been designed in a way so that learner shall be acquainted with many Interdisciplinary subjects.

Automobile Engineering is one of the fastest growing sectors, with lots of inventions and innovations happening. The graduating Automobile Engineers can contribute in the areas such as engines, transmission, safety and stability, energy and alternate energy etc. The challenges for our budding engineers would be manifold, when electric vehicles are already gaining popularity and driverless cars becoming a reality.

Engineers develop new technological solutions. During the engineering design process, the responsibilities of the engineer may include defining problems, conducting and narrowing research, analyzing criteria, finding and analyzing solutions, and making decisions. The Program Educational Objectives proposed for the undergraduate program in Automobile Engineering are listed below;

1. To prepare the stake holder to exhibit leadership qualities with demonstrable attributes in lifelong learning to contribute to the societal needs.
2. To make ready the stake holder to pursue higher education for professional development
3. To help the stake holder to acquire the analytical and technical skills, knowledge, analytical ability attitude and behavior through the program
4. To prepare the stakeholders with a sound foundation in the mathematical, scientific and engineering fundamentals
5. To motivate the learner in the art of self-learning and to use modern tools for solving real life problems and also inculcate a professional and ethical attitude and good leadership qualities
6. To Prepare the stake holder to able to Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

We trust this revised version of syllabus come up to the expectations of all stakeholders. We wish to place on record our sincere thanks and appreciations to the various contributors from the academia and industry for their most learned inputs in framing this syllabus.

### **Board of Studies in Mechanical Engineering**

Dr. Vivek K. Sunnapwar	: Chairman
Dr. S. M. Khot	: Member
Dr. V. M. Phalle	: Member
Dr. Siddappa Bhusnoor	: Member
Dr. S.S. Pawar	: Member
Dr. Sanjay U. Bokade	: Member
Dr. Dhanraj Tambuskar	: 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
AEC301	Engineering Mathematics-III <sup>#</sup>	3	--	1	3	--	1	4
AEC302	Strength of Materials <sup>#</sup>	3		--	3		--	3
AEC303	Production Processes <sup>#</sup>	4	--	--	4	--	--	4
AEC304	Materials and Metallurgy <sup>#</sup>	3	--	--	3	--	--	3
AEC305	Thermodynamics <sup>#</sup>	3	--	--	3	--	--	3
AEL301	Materials Testing <sup>#</sup>	--	2	--	--	1	--	1
AEL302	Machine Shop Practice <sup>#</sup>	--	4	--	--	2	--	2
AESBL301	CAD –Modeling <sup>#</sup>	--	4	--	--	2	--	2
AEPBL301	Mini Project – 1A	--	4 <sup>\$</sup>	--	--	2	--	2
<b>Total</b>		<b>16</b>	<b>14</b>	<b>1</b>	<b>16</b>	<b>07</b>	<b>1</b>	<b>24</b>

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg .					
AEC301	Engineering Mathematics-III <sup>#</sup>	20	20	20	80	3	25	--	125
AEC302	Strength of Materials <sup>#</sup>	20	20	20	80	3	--	--	100
AEC303	Production Processes <sup>#</sup>	20	20	20	80	3	--	--	100
AEC304	Materials and Metallurgy <sup>#</sup>	20	20	20	80	3	--	--	100
AEC305	Thermodynamics <sup>#</sup>	20	20	20	80	3	--	--	100
AEL301	Materials Testing <sup>#</sup>	--	--	--	--	--	25	25	50
AEL302	Machine Shop Practice <sup>#</sup>	--	--	--	--	--	50		50
AESBL301	CAD –Modeling <sup>#</sup>	--	--	--	--	--	25	25	50
AEPBL301	Mini Project – 1A	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>	<b>75</b>	<b>725</b>

<sup>\$</sup> indicates work load of Learner (Not Faculty), for Mini Project

<sup>#</sup> indicates common with Mechanical Engineering

SBL – Skill Based Laboratory, PBL – Project Based Learning

**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
AEC401	Engineering Mathematics-IV <sup>#</sup>	3	--	1	3	--	1	4	
AEC402	Fluid Mechanics <sup>#</sup>	3	--	--	3	--	--	3	
AEC403	Kinematics of Machinery <sup>#</sup>	3	--	--	3	--	--	3	
AEC404	CAD/CAM <sup>#</sup>	3	--	--	3	--	--	3	
AEC405	Industrial Electronics <sup>#</sup>	3	--	--	3	--	--	3	
AEL401	Industrial Electronics <sup>#</sup>	--	2	--	--	1	--	1	
AEL402	Kinematics of Machinery <sup>#</sup>	--	2	--	--	1	--	1	
AEL403	Python Programming <sup>#</sup>	--	2	--	--	1	--	1	
AESBL401	CNC & 3-D Printing <sup>#</sup>	--	4	--	--	2	--	2	
AEPBL401	Mini Project – 1B	--	4 <sup>\$</sup>	--	--	2	--	2	
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>23</b>	
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Pract/oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem. Exam.</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test 1</b>	<b>Test 2</b>	<b>Avg.</b>					
AEC401	Engineering Mathematics-IV <sup>#</sup>	20	20	20	80	3	25	--	125
AEC402	Fluid Mechanics <sup>#</sup>	20	20	20	80	3	--	--	100
AEC403	Kinematics of Machinery <sup>#</sup>	20	20	20	80	3	--	--	100
AEC404	CAD/CAM <sup>#</sup>	20	20	20	80	3	--	--	100
AEC405	Industrial Electronics <sup>#</sup>	20	20	20	80	3	--	--	100
AEL401	Industrial Electronics <sup>#</sup>	--	--	--	--	--	25	25	50
AEL402	Kinematics of Machinery <sup>#</sup>	--	--	--	--	--	25	--	25
AEL403	Python Programming <sup>#</sup>	--	--	--	--	--	25	25	50
AESBL401	CNC & 3-D Printing <sup>#</sup>	--	--	--	--	--	25	25	50
AEPBL401	Mini Project – 1B	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>	<b>100</b>	<b>750</b>

<sup>\$</sup> indicates work load of Learner (Not Faculty), for Mini Project

<sup>#</sup> indicates common with Mechanical Engineering

SBL – Skill Based Laboratory, PBL – Project Based Learning

**Students group and load of faculty per week.**

**Mini Project 1A / 1B:** Students can form groups with minimum 3 (Three) members and not more than 4 (Four) members

**Faculty Load:** 1 hour per week per four groups

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Automobile Engineering

Third Year with Effect from AY 2021-22

(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)



## Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Third Year B.E. in Automobile Engineering</b>
2	Eligibility for Admission	<b>After Passing Second Year Engineering as per the Ordinance 0.6243</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6243</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./Diploma / Certificate</b> (Strike out which is not applicable)
7	Pattern	<b>Yearly / Semester</b> (Strike out which is not applicable )
8	Status	<b>New / Revised</b> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>2021-2022</b>

Date

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 171, 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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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.

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Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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Dr. S.S. Pawar : Member  
Dr. Sanjay U. Bokade : Member  
Dr. Dhanraj Tambuskar : Member



**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			
AEC501	Mechanical Measurements & Controls #	3	--	3	--	3			
AEC502	Internal Combustion Engines	3	--	3	--	3			
AEC503	Machine Design	3	--	3	--	3			
AEC504	Finite Element Analysis #	3	--	3	--	3			
AEDLO501X	Department Level Optional Course – 1#	3	--	3	--	3			
AEL501	Measurement and Engine Testing Lab	--	2	--	1	1			
AEL502	Machine Design	--	2	--	1	1			
AEL503	Finite Element Analysis#	--	2	--	1	1			
AESBL501	Professional Communication and Ethics - II #	--	2*+2	--	2	2			
AEPBL501	Mini Project – 2 A	--	4\$	--	2	2			
<b>Total</b>		<b>15</b>	<b>14</b>	<b>15</b>	<b>07</b>	<b>22</b>			
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					<b>Term Work</b>	<b>Prac/oral</b>	<b>Total</b>
		<b>Internal Assessment</b>			<b>End Sem Exam</b>	<b>Exam. Duration (in Hrs)</b>			
		<b>Test1</b>	<b>Test2</b>	<b>Avg</b>					
AEC501	Mechanical Measurements & Controls #	20	20	20	80	3	--	--	100
AEC502	Internal Combustion Engines	20	20	20	80	3	--	--	100
AEC503	Machine Design	20	20	20	80	3	--	--	100
AEC504	Finite Element Analysis #	20	20	20	80	3	--	--	100
AEDLO501X	Department Level Optional Course – 1#	20	20	20	80	3	--	--	100
AEL501	Measurement and Engine Testing Lab	--	--	--	--	--	25	25	50

AEL502	Machine Design	--	--	--	--	--	25	--	50
AEL503	Finite Element Analysis <sup>#</sup>	--	--	--	--	--	25	25	50
AESBL501	Professional Communication and Ethics - II <sup>#</sup>	--	--	--	--	--	25	25	50
AEPBL501	Mini Project – 2 A	--	--	--	--	--	25	25	50
<b>Total</b>		--	--	<b>100</b>	<b>400</b>	--	<b>125</b>	<b>100</b>	<b>725</b>

### Department Level Optional Course – 1

Course Code	Department Level Optional Course – 1
AEDLO5011	Optimization Techniques <sup>#</sup>
AEDLO5012	Design of Experiments <sup>#</sup>
AEDLO5013	Computational Methods <sup>#</sup>

\* Theory class to be conducted for full class

\$ indicates work load of Learner (Not Faculty), for Mini Project

# indicates common with Mechanical Engineering

**Note:** Students are required to undergo Internship (Garage Training) of minimum 4 weeks in vacation of Semester V.

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

Civil Engineering (Final Year – Sem.VII&VIII), Revised course

(REV- 2012) from Academic Year 2015 -16,

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit Grading System)

# Preface

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) give freedom to affiliated Institutes to add few (PEO's) courseobjectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, semester based credit grading system is also introduced to ensure quality of engineering education.

Semester based Credit 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 not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Credit grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year Final Year Engineering in the academic years 2014-2015, 2015-2016, respectively.

**Dr. S. K. Ukarande**  
**Dean,**  
**Faculty of Technology,**  
**Member - Management Council, Senate, Academic Council**  
**University of Mumbai, Mumbai**

## Preamble

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education reflects the fact that in achieving recognition, the institution or program of study is committed open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I am happy to state here that, Program Educational Objectives were finalized in a meeting where syllabus committee members were also present. The Program Educational Objectives finalized for undergraduate program in civil Engineering are as follows:

1. To prepare Learner's with a sound foundation in the mathematical, scientific engineering fundamentals
2. To prepare Learner's to use effectively modern tools to solve real life problems
3. To prepare Learner's for successful career in Indian Multinational Organisations to excel in Postgraduate studies
4. To encourage motivate Learner's for self-learning
5. To inculcate professional ethical attitude, good leadership qualities commitment to social responsibilities in the Learner's

In addition to above each institute is free to add few (2 to 3) more Program Educational Objectives of their own. In addition to Program Educational Objectives, course objectives expected course outcomes from learner's point of view are also included in the curriculum for each course of undergraduate program to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stakeholders.

**Dr. S. K. Ukarande**

**Chairman, Board of studies in Civil Engineering**

**University of Mumbai, Mumbai**

**University of Mumbai**  
**Scheme of Instruction and Examination**  
**Fourth Year Engineering (Civil Engineering)**  
**(With effect from 2015-2016)**  
**Semester VII**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C701	Limit State Method for Reinforced Concrete Structures	4	2	--	4	1	--	5		
CE-C702	Quantity Survey Estimation and Valuation	4	2	--	4	1	--	5		
CE-C703	Irrigation Engineering	4	2	--	4	1	--	5		
CE-C704	Environmental Engineering – II	4	2	--	4	1	--	5		
CE-E705	Elective – I	4	2	--	4	1	--	5		
CE-P706	Project – Part I	--	4	--	--	2	--	2		
<b>Total</b>		<b>20</b>	<b>14</b>	<b>--</b>	<b>20</b>	<b>7</b>	<b>--</b>	<b>27</b>		
Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
Test 1	Test 2	Avg								
CE-C701	Limit State Method for Reinforced Concrete Structures	20	20	20	80	3	25	--	--	125
CE-C702	Quantity Survey Estimation and Valuation	20	20	20	80	4	25	--	25	150
CE-C703	Irrigation Engineering	20	20	20	80	3	25	--	25	150
CE-C704	Environmental Engineering – II	20	20	20	80	3	25	--	25	150
CE-E705	Elective – I	20	20	20	80	3	25	--	25	150
CE-P706	Project – Part I	--	--	--	--	--	50	--	25 <sup>@</sup>	75
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>--</b>	<b>125</b>	<b>800</b>

<sup>@</sup> Seminar on Project (Internal)

**Semester VIII**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C801	Design and Drawing of Reinforced Concrete Structures	4	2	--	4	1	--	5		
CE-C802	Construction Engineering	4	2	--	4	1	--	5		
CE-C803	Construction Management	4	2	--	4	1	--	5		
CE-E804	Elective – II	4	2	--	4	1	--	5		
CE-P805	Project – Part II	--	8	--	--	4	--	4		
<b>Total</b>		<b>16</b>	<b>16</b>	<b>--</b>	<b>16</b>	<b>8</b>	<b>--</b>	<b>24</b>		
Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C801	Design and Drawing of Reinforced Concrete Structures	20	20	20	80	4	25	--	25	150
CE-C802	Construction Engineering	20	20	20	80	3	25	--	25	150
CE-C803	Construction Management	20	20	20	80	3	25	--	25	150
CE-E804	Elective – II	20	20	20	80	3	25	--	25	150
CE-P805	Project – Part II	--	--	--	--	--	50	--	50 <sup>#</sup>	100
<b>Total</b>		<b>80</b>	<b>80</b>	<b>80</b>	<b>320</b>		<b>150</b>	<b>--</b>	<b>150</b>	<b>700</b>

<sup>#</sup> Presentation on Project and Oral (Internal and External)

**N.B.:** Guidelines for Project, i.e., Dissertation (Part-I& II)

- (i) Students can form groups with minimum of 2 (Two) and not more than 4 (Four)
- (ii) Faculty load: In Semester VII – 1 (One) period of 1 hour per week per project group.
- (iii) In Semester VIII- 2 (Two) periods of 1 hour each per week per project group.
- (iv) Each faculty member shall be permitted to guide maximum 4 (Four) project groups.

**University of Mumbai**

**Fourth Year Civil Engineering**

**List of Electives**

**Semester VII (Theory: 4, Practical: 2)**

1. Advanced Surveying
2. Rock Mechanics
3. Applied Hydrology Flood Control
4. Solid Waste Management
5. Systems Approach in Civil Engineering
6. Risk Value Management
7. Advanced Structural Analysis
8. Structural Dynamics
9. Advanced Structural Mechanics
10. Advanced Foundation Engineering
11. Ground Water Hydrology
12. Pavement Subgrade Materials
13. Air Pollution
14. Prestressed Concrete
15. Traffic Engineering Control
16. Reinforced Concrete Repairs Maintenance
17. Advanced Computational Techniques

**Semester VIII (Theory: 4, Practical: 2)**

1. Advanced Construction Engineering
2. Advanced Engineering Geology
3. Geographical Information Systems
4. Water Resources Engineering Management
5. Bridge Design Engineering
6. Environmental Impact Assessment Audit
7. Appraisal Implementation of Infrastructure Projects
8. Disaster Management
9. Pavement Design and Construction
10. Advanced Design of Steel Structures
11. Earthquake Engineering
12. Soil Dynamics
13. Building Services
14. Design of Hydraulic Structures
15. Industrial Waste Treatment
16. Transportation Planning Economics
17. Advanced Repairs and Rehabilitation of Structures
18. Geosynthetics and Reinforced Structures



# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

Civil Engineering (Second Year – Sem. III & IV)

Revised course (REV – 2016)

With Effect From Academic Year 2017 – 18

Under the

FACULTY OF TECHNOLOGY

(As per Semester Choice Based Credit and Grading System)

# Preface

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) give freedom to affiliated Institutes to add few (PEO's) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, semester based credit grading system is also introduced to ensure quality of engineering education.

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 not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Credit grading based system was implemented for First Year of Engineering from the academic year 2016 – 2017. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2017 – 2018, for Third Year and Final Year Engineering in the academic years 2018 – 2019, 2019 – 2020, respectively.

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

## Preamble

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education reflects the fact that in achieving recognition, the institution or program of study is committed open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I am happy to state here that, Program Educational Objectives were finalized in a meeting where syllabus committee members were also present. The Program Educational Objectives finalized for undergraduate program in civil Engineering are as follows:

1. To prepare Learner's with a sound foundation in the mathematical, scientific engineering fundamentals
2. To prepare Learner's to use effectively modern tools to solve real life problems
3. To prepare Learner's for successful career in Indian Multinational Organisations to excel in Postgraduate studies
4. To encourage motivate Learner's for self-learning
5. To inculcate professional ethical attitude, good leadership qualities commitment to social responsibilities in the Learner's

In addition to above each institute is free to add few (2 to 3) more Program Educational Objectives of their own. In addition to Program Educational Objectives, course objectives expected course outcomes from learner's point of view are also included in the curriculum for each course of undergraduate program to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

**Dr. S. K. Ukarande**

**Chairman, Board of studies in Civil Engineering**

**University of Mumbai, Mumbai**

**University of Mumbai**  
**Scheme of Instructions and Examination**  
**Second Year Engineering (Civil Engineering)**  
**(With effect from 2017 – 2018)**  
**(Semester–III)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CE-C301	Applied Mathematics–III*	4	-	1	4	-	1	5
CE-C302	Surveying – I	4	2	1	4	1	1	5
CE-C303	Strength of Materials	4	2	1	4	1	1	5
CE-C304	Engineering Geology	3	2	1	3	1	1	4
CE-C305	Fluid Mechanics – I	3	2	1	3	1	1	4
<b>Total</b>		<b>17</b>	<b>8</b>	<b>1</b>	<b>17</b>	<b>4</b>	<b>1</b>	<b>23</b>

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Practical	Total
		Internal Assessment			End Sem Exam	Exam Duration			
		Test1	Test2	Avg.					
CE-C301	Applied Mathematics – III	20	20	20	80	3	25	-	125
CE-C302	Surveying – I	20	20	20	80	3	25	25	150
CE-C303	Strength of Materials	20	20	20	80	3	25	25	150
CE-C304	Engineering Geology	20	20	20	80	3	25	25	150
CE-C305	Fluid Mechanics – I	20	20	20	80	3	25	25	150
<b>Total</b>		--	--	<b>100</b>	<b>400</b>	-	<b>125</b>	<b>100</b>	<b>725</b>

\*Common with Mechanical/ Automobile/ Mechatronics

**University of Mumbai**  
**Scheme of Instructions and Examination**  
**Second Year Engineering (Civil Engineering)**  
**(With effect from 2017 – 2018)**  
**(Semester – IV)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CE-C401	Applied Mathematics–IV*	4	-	1	4	-	1	5
CE-C402	Surveying–II	3	3	1	3	1.5	1	4.5
CE-C403	Structural Analysis–I	4	2	1	4	1	1	5
CE-C404	Building Design & Drawing	2	3	1	2	1.5	1	3.5
CE-C405	Building Materials & Construction Technology	4	2	1	4	1	1	5
CE-C406	Fluid Mechanics–II	3	2	1	3	1	1	4
<b>Total</b>		<b>20</b>	<b>12</b>	<b>1</b>	<b>20</b>	<b>6</b>	<b>1</b>	<b>27</b>

Course Code	Course Name	Examination Scheme							Total
		Theory					TW	Oral & Practical	
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test2	Avg.					
CE-C401	Applied Mathematics-IV*	20	20	20	80	3	25	--	125
CE-C402	Surveying–II	20	20	20	80	3	50	25**	175
CE-C403	Structural Analysis–I	20	20	20	80	3	25	25	150
CE-C404	Building Design & Drawing	20	20	20	80	4	25	25@	150
CE-C405	Building Materials & Construction Technology	20	20	20	80	3	25	25	150
CE-C406	Fluid Mechanics–II	20	20	20	80	3	25	25	150
<b>Total</b>		--	--	<b>120</b>	<b>480</b>	--	<b>150</b>	--	<b>900</b>

\* Common with Mechanical/ Automobile/ Mechatronics

\*\* For the course 'Surveying-II (CE-C 402), the oral examination will be conducted in conjunction with practical/s/

@ For the course 'Building Design and Drawing (CE-C 404), the oral examination shall be conducted in conjunction with the sketching examination.

**University of Mumbai**  
**Scheme of Instructions and Examination**  
**Third Year Engineering (Civil Engineering)**  
**(With effect from 2018– 2019)**  
**(Semester –V)**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Practs.	Tut.	Total
CE-C501	Structural Analysis – II	4	2	--	4	1	--	5
CE-C502	Geotechnical Engg.– I	3	2	--	3	1	--	4
CE-C503	Applied Hydraulics	3	2	--	3	1	--	4
CE-C504	Environmental Engineering –I	3	2	--	3	1	--	4
CE-C505	Transportation Engineering – I	3	2	--	3	1	--	4
CE-DLO506X	Department Level Optional Course –I	3	2	--	3	1	--	4
CE-C507	Business and Communication Ethics	--	4#	--	--	2	--	2
<b>Total</b>		<b>19</b>	<b>16</b>	<b>--</b>	<b>19</b>	<b>8</b>	<b>--</b>	<b>27</b>

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Practs.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (In Hrs.)				
		Test1	Test 2	Avg						
CE-C501	Structural Analysis – II	20	20	20	80	3	25	--	25	150
CE-C502	Geotechnical Engineering – I	20	20	20	80	3	25	--	25	150
CE-C503	Applied Hydraulics	20	20	20	80	3	25	--	25	150
CE-C504	Environmental Engineering –I	20	20	20	80	3	25	--	25	150
CE-C505	Transportation Engineering – I	20	20	20	80	3	25	--	25	150
CE-DLO506X	Department Level Optional Course –I	20	20	20	80	3	25	--	25	150
CE-C507	Business and Communication Ethics	--	--	--	--	--	25	--	25*	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>120</b>	<b>480</b>	<b>--</b>	<b>175</b>	<b>--</b>	<b>175</b>	<b>950</b>

**University of Mumbai**  
**Scheme of Instructions and Examination**  
**Third Year Engineering (Civil Engineering)**  
**(With effect from 2018– 2019)**  
**(Semester –VI)**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Practs.	Tut.	Total
CE-C601	Geotechnical Engg. – II	3	2	--	3	1	--	4
CE-C602	Design and Drawing of Steel Structures	4	2	--	4	1	--	5
CE-C603	Transportation Engg. – II	3	2	--	3	1	--	4
CE-C604	Environmental Engg – II	3	2	--	3	1	--	4
CE-C605	Water Resource Engineering – I	3	2	--	3	1	--	4
CE-DLO606X	Department Level Optional Course –II	3	2	--	3	1	--	4
CE-C507	Software Applications in Civil Engineering	--	2	--	--	1	--	1
<b>Total</b>		<b>19</b>	<b>14</b>	<b>--</b>	<b>19</b>	<b>7</b>	<b>--</b>	<b>26</b>

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (In Hrs.)				
		Test1	Test 2	Avg						
CE-C601	Geotechnical Engg. – II	20	20	20	80	3	25	--	25	150
CE-C602	Design and Drawing of Steel Structures	20	20	20	80	4	25	--	25 <sup>@</sup>	150
CE-C603	Transportation Engg. – II	20	20	20	80	3	25	--	--	125
CE-C604	Environmental Engg – II	20	20	20	80	3	25	--	25	150
CE-C605	Water Resource Engineering – I	20	20	20	80	3	25	--	25	150
CE-DLO606X	Department Level Optional Course –II	20	20	20	80	3	25	--	25	150
CE-C507	Software Applications in Civil Engineering	--	--	--	--	--	25	--	--	25
<b>Total</b>		<b>120</b>	<b>120</b>	<b>120</b>	<b>480</b>		<b>175</b>	<b>--</b>	<b>125</b>	<b>900</b>

# For the course ‘ Business and Communication Ethics (CE- C507), although 04 (Four) clock hours are mentioned under the head of Practicals, 02 (Two) clock hours out of these 04 (Four) clock hours may be utilized as the Theory at the Institute/ College Level so as to enable the instructor (teacher) to impart the theoretical aspects of the said course. Accordingly, the provision may be made in the Time Table.

\* Further, the oral examination in respect of the course ‘Business and Communication Ethics (CE-C 507)’ will be conducted in conjunction with seminar/ presentation.

@ For the course, Design and Drawing of Steel Structures (CE-C 602), the oral examination will be conducted in conjunction with sketching.

<b>Department Level Optional Course – I</b>	<b>Department Level Optional Course – II</b>
CE-DLO 5061: Advanced Surveying	CE-DLO6061: Advanced Construction Equipments
CE-DLO 5062: Advanced Concrete Technology	CE-DLO6062: Traffic Engineering and Management
CE-DLO 5063: Building Services and Repairs	CE-DLO6063: Ground Improvement Techniques
CE-DLO 5064: Advanced Structural Mechanics	CE-DLO6064: Advanced Structural Analysis



**University of Mumbai**  
**Scheme of Instructions and Examination**  
**Fourth Year Engineering (Civil Engineering)**  
**(With effect from 2019– 2020)**  
**(Semester –VII)**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Practs.	Tut.	Total
CE-C701	Quantity Survey Estimation and Valuation	4	2	--	4	1	--	5
CE-C702	Theory of Reinforced Concrete Structures	4	2	--	4	1	--	5
CE-C703	Water Resource Engineering – II	3	2	--	3	1	--	4
CE-DLO704X	Department Level Optional Course –III	3	2	--	3	1	--	4
CE-ILO705X	Institute Level Optional Course –I	3	--	--	3	--	--	3
CE-C706	Project – Part I	--	4	--	--	2	--	2
<b>Total</b>		<b>17</b>	<b>12</b>	<b>1</b>	<b>17</b>	<b>6</b>	<b>1</b>	<b>23</b>

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (In Hrs.)				
		Test1	Test 2	Avg						
CE-C701	Quantity Survey Estimation and Valuation	20	20	20	80	4	25	--	25	150
CE-C702	Theory of Reinforced Concrete Structures	20	20	20	80	3	25	--	25	150
CE-C703	Water Resource Engineering – II	20	20	20	80	3	25	--	25	150
CE-DLO704X	Department Level Optional Course –III	20	20	20	80	3	25	--	25	150
CE-ILO705X	Institute Level Optional Course – I	20	20	20	80	3	--	--	-	100
CE-P706	Project – Part I	--	--	--	--	--	50	--	25 <sup>@</sup>	75
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>		<b>150</b>	<b>--</b>	<b>125</b>	<b>775</b>

@ For Project- PartI (CE-P 706), the oral examination shall be based on the presentation/ seminar before the board of internal examiners to be appointed by the Head of the concerned Department.

**University of Mumbai**  
**Scheme of Instructions and Examination**  
**Fourth Year Engineering (Civil Engineering)**  
**(With effect from 2019– 2020)**  
**(Semester – VIII)**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Practs.	Tut.	Total
CE-C801	Design and Drawing of Reinforced Concrete Structures	4	2	--	4	1	--	5
CE-C802	Construction Management	4	2	--	4	1	--	5
CE-DLO803X	Department Level Optional Course – IV	4	2	--	4	1	--	5
CE-ILO804X	Institute Level Optional Course – II	3	--	1	3	--	1	4
CE-C805	Project – Part II	--	8	--	--	4	--	4
<b>Total</b>		<b>15</b>	<b>16</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>23</b>

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (In Hrs.)				
		Test1	Test 2	Avg						
CE-C801	Design and Drawing of Reinforced Concrete Structures	20	20	20	80	4	25	--	25	150
CE-C802	Construction Management	20	20	20	80	3	25	--	25	150
CE-DLO803X	Department Level Optional Course – IV	20	20	20	80	3	25	--	25	150
CE-ILO804X	Institute Level Optional Course – II	20	20	20	80	3	25	--	--	100
CE-P 806	Project – Part II	--	--	--			50	--	50 <sup>#</sup>	100
<b>Total</b>		--	--	<b>80</b>	<b>320</b>		<b>150</b>		<b>125</b>	<b>675</b>

<sup>#</sup> The oral examination for the Project- Part II (CE-P 806) shall be based on the presentation/ seminar to be delivered by the projectee/s before the board of examiners. The board of internal examiners will comprise of the internal examiners and the external examiners to be approved by the University from the pool of eligible examiners.

Guidelines for Project, i.e., Dissertation (Part-I and II)

- (i) Students can form groups with minimum of 2 (Two) students and not more than 4 (Four) students.
- (ii) Faculty load: In Semester VII:01 (One) clock hour per week per project group and in Semester VIII: 02 (Two) clock hours per week per project group.
- (iii) Each faculty member shall be permitted to guide maximum 04 (Four) project groups.

<b>Department Level Optional Course – III</b> (Semester – VII)	<b>Department Level Optional Course – IV</b> (Semester – VIII)
CE-DLO7041: Prestressed Concrete	CE-DLO8031: Advanced Design of Steel Structures
CE-DLO7042: Solid Waste management	CE-DLO8032: Industrial Waste Treatment
CE-DLO7043: Pavement Subgrade and Materials	CE-DLO8033: Pavement Design and Construction
CE-DLO7044: Structural Dynamics	CE-DLO8034: Bridge Engineering and Design
CE-DLO7045: Application of GIS and Remote Sensing	CE-DLO8035: Appraisal and Implementation of Infrastructure Projects
CE-DLO7046: Foundation Analysis and Design	CE-DLO8036: Soil Dynamics
CE-DLO7047: Applied Hydrology and Flood Control	CE-DLO8037: Design of Hydraulic Structures

<b>Institute Level Optional Course – I</b> (Semester –VII)	<b>Institute Level Optional Course – II</b> (Semester – VIII)
CE-ILO7051: Product Life Cycle Management	CE-ILO8041: Project Management
CE-ILO7052: Reliability Engineering	CE-ILO8042: Finance Management
CE-ILO7053: Management Information Systems	CE-ILO8043: Entrepreneurship Development and Management
CE-ILO7054: Design of Experiments	CE-ILO8044: Human Resources Management
CE-ILO7055: Operations Research	CE-ILO8045: Professional Ethics and Corporate Social Responsibility (CSR)
CE-ILO7056: Cyber Security and Laws	CE-ILO8046: Research Methodology
CE-ILO7057: Disaster Management and Mitigation Measures	CE-ILO8047: Intellectual Property Rights and Patenting
CE-ILO7058: Energy Audit and Management	CE-ILO8048: Environment Management
	CE-ILO8049: Digital Business Management

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering in Civil 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)

Item No: -125

AC- 23/7/2020

## UNIVERSITY OF MUMBAI



### Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year B.E. Civil Engineering</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>U.G.</b>
7	Pattern	<b>Semester</b>
8	Status	<b>New</b>
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2020-2021</b>

Date

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 13 weeks and remaining 2 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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## Preface

The engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program Outcomes (POs) are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education (OBE) in the process of curriculum development from Rev-2012 onwards and continued to enhance the curriculum further based on OBE in Rev-2016 and Rev-2019 “C” scheme.

As Chairman and Members of Board of Studies in Civil Engineering, University of Mumbai, we are happy to state here that, the Program Educational Objectives (PEOs) for Undergraduate Program were finalized in a brain storming sessions, which was attended by more than 40 members from different affiliated Institutes of the University, who are either Heads of Departments or their senior representatives from the Department of Civil Engineering. The PEOs finalized for the undergraduate program in Civil Engineering are listed below;

1. To prepare the Learner with a sound foundation in mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To prepare the Learner for a successful career in Indian and Multinational Organisations and for excelling in post-graduate studies
4. To motivate learners for life-longing learning
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner’s thought process

In addition to the above listed PEOs, every institute is encouraged to add a few (2-3) more PEOs suiting their institute vision and mission

Apart from the PEOs, for each course of the program, objectives and expected outcomes from a learner’s point of view are also included in the curriculum to support the philosophy of OBE. We strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

### **Board of Studies in Civil Engineering, University of Mumbai**

- |                        |          |
|------------------------|----------|
| 1. Dr. S. K. Ukarande: | Chairman |
| 2. Dr. K. K. Sangle:   | Member   |
| 3. Dr. S. B. Charhate: | Member   |
| 4. Dr. A. R. Kambekar: | Member   |
| 5. Dr. R. B. Magar:    | Member   |
| 6. Dr. Seema Jagtap:   | 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			Total
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	
CEC301	Engineering Mathematics-III	3	-	1	3	-	1	4
CEC302	Mechanics of Solids	4			4			4
CEC303	Engineering Geology	3			3			3
CEC304	Architectural Planning & Design of Buildings	2	-	-	2	-	-	2
CEC305	Fluid Mechanics- I	3	-	-	3	-	-	3
CEL301	Mechanics of Solids	1	2	1	1	1	1	1
CEL302	Engineering Geology	1	2	1	1	1	1	1
CEL303	Architectural Planning & Design of Buildings	1	2	1	1	1	1	1
CEL304	Fluid Mechanics- I	1	2	1	1	1	1	1
CEL305	Skill Based Lab Course-I		3		1	1.5		1.5
CEM301	Mini Project – 1 A	1	3 <sup>s</sup>	1	1	1.5	1	1.5
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>7</b>	<b>1</b>	<b>23</b>

<b>Examination Scheme</b>									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)-	Term Work	Prac. /Oral	Total
		Test I	Test II	Avg .					
CEC301	Engineering Mathematics-III	20	20	20	80	3	25	-	125
CEC302	Mechanics of Solids	20	20	20	80	3	-	-	100
CEC303	Engineering Geology	20	20	20	80	3	-	-	100
CEC304	Architectural Planning & Design of Buildings	20	20	20	80	3	-	-	100
CEC305	Fluid Mechanics- I	20	20	20	80	3	-	-	100
CEL301	Mechanics of Solids	-	-	-	-	-	25	25	50
CEL302	Engineering Geology	-	-	-	-	-	25	25	50
CEL303	Architectural Planning & Design of Buildings	-	-	-	-	-	25	25	50
CEL304	Fluid Mechanics- I	-	-	-	-	-	25	25	50
CEL305	Skill Based Lab Course-I	-	-	-	-	-	50	-	50
CEM301	Mini Project – 1 A	-	-	-	-	-	25	25	50
	<b>Total</b>			<b>100</b>	<b>400</b>	<b>-</b>	<b>200</b>	<b>125</b>	<b>825</b>

## Semester – IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			Total
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	
CEC401	Engineering Mathematics - IV	3	--	1	3	-	1	4
CEC402	Structural Analysis	4	--	-	4	-	-	4
CEC403	Surveying	3	--	-	3	-	-	3
CEC404	Building Materials & Concrete Technology	3	--	-	3	-	-	3
CEC405	Fluid Mechanics-II	3	-	-	3	-	-	3
CEL 401	Structural Analysis	--	2	1	1	1	1	1
CEL 402	Surveying	--	3	1	1	1.5	1	1.5
CEL 403	Building Material Concrete Technology	--	2	1	1	1	1	1
CEL 404	Fluid Mechanics-II	--	2	1	1	1	1	1
CEL 405	Skill Based lab Course-II	--	2	1	1	1	1	1
CEM401	Mini Project – 1 B	--	3 <sup>s</sup>	1	1	1.5	1	1.5
<b>Total</b>		<b>16</b>	<b>14</b>	<b>1</b>	<b>16</b>	<b>7</b>	<b>1</b>	<b>24</b>

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)-	Term Work	Prac. /Oral	Total
		Test I	Test II	Avg .					
CEC 401	Engineering Mathematics - IV	20	20	20	80	3	25	-	125
CEC 402	Structural Analysis	20	20	20	80	3	-	-	100
CEC 403	Surveying	20	20	20	80	3			100
CEC 404	Building Materials & Concrete Technology	20	20	20	80	3	-	-	100
CEC 405	Fluid Mechanics-II	20	20	20	80	3	-	-	100
CEL 401	Structural Analysis						25	25	50
CEL 402	Surveying						50	25	75
CEL 403	Building Materials & Concrete Technology	-	-	-	-	-	25	25	50
CEL 404	Fluid Mechanics-II	-	-	-	-	-	25	25	50
CEL 405	Skill Based lab Course-II	-	-	-	-	-	50	-	50
CEM401	Mini Project – 1 B	-	-	-	-	-	25	25	50
	<b>Total</b>			<b>100</b>	<b>400</b>	<b>-</b>	<b>225</b>	<b>125</b>	<b>850</b>

## Undergraduate Program Structure for Third year Civil Engineering

University of Mumbai

(With Effect from A. Y. 2021-2022)

Semester - V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC501	Theory of Reinforced Concrete Structures	03	-	-	03	-	-	03
CEC502	Applied Hydraulics	03	-	-	03	-	-	03
CEC503	Geotechnical Engineering-I	03	-	-	03	-	-	03
CEC504	Transportation Engineering	04	-	-	04	-	-	04
CEDLO501X	Department Level Optional Course-1	03	-	-	03	-	-	03
CEL501	Theory of Reinforced Concrete Structures	!	02	!	!	01	!	01
CEL502	Applied Hydraulics	!	02	!	!	01	!	01
CEL503	Geotechnical Engineering-I	!	02	!	!	01	!	01
CEL504	Transportation Engineering	!	02	!	!	01	!	01
CEL505	Professional Communication and Ethics	!	02*+2	-	!	02	!	02
CEM501	Mini Project – 2A	!	04\$	!	!	02	!	02
<b>Total</b>		<b>16</b>	<b>16</b>	<b>-</b>	<b>16</b>	<b>08</b>	<b>-</b>	<b>24</b>

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract /Oral	Total
		Test - I	Test - II	Avg.					
CEC501	Theory of Reinforced Concrete Structures	20	20	20	80	03	-	-	100
CEC502	Applied Hydraulics	20	20	20	80	03	-	-	100
CEC503	Geotechnical Engineering-I	20	20	20	80	03	-	-	100
CEC504	Transportation Engineering	20	20	20	80	03	-	-	100
CEDLO501X	Department Level Optional Course -1	20	20	20	80	03	-	-	100
CEL501	Theory of Reinforced Concrete Structures	-	-	-	-	-	25	25	50
CEL502	Applied Hydraulics	-	-	-	-	-	25	25	50
CEL503	Geotechnical Engineering-I	-	-	-	-	-	25	25	50
CEL504	Transportation Engineering	-	-	-	-	-	25	25	50
CEL505	Professional Communication and Ethics	-	-	-	-	-	25	25	50
CEM501	Mini Project – 2A	-	-	-	-	-	25	25	50
<b>Total</b>		<b>100</b>			<b>400</b>	<b>-</b>	<b>150</b>	<b>150</b>	<b>800</b>

\* Theory class to be conducted for full class

\$ indicates work load of Learner (Not Faculty), for Mini Project

**Undergraduate Program Structure for Third year Civil Engineering**  
**University of Mumbai**  
(With Effect from A. Y. 2021-2022)  
**Semester - V**

**Department Level Optional Course – 1**

<b>Sr. No.</b>	<b>Course Code CEDLO501X</b>	<b>Department Level Optional Course – 1</b>
1	CEDLO5011	Modern Surveying Instruments and Techniques
2	CEDLO5012	Building Services & Repairs
3	CEDLO5013	Sustainable Building Materials
4	CEDLO5014	Advanced Structural Mechanics
5	CEDLO5015	Air and Noise Pollution & Control
6	CEDLO5016	Transportation Planning & Economics
7	CEDLO5017	Advanced Concrete Technology

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering Electronics and Telecommunication Engineering

Final Year Engineering  
(Sem. VII and VIII), Revised course  
(REV- 2012) effective from Academic Year 2014 -15

Under  
FACULTY OF TECHNOLOGY  
(As per Semester Based Credit and Grading System)

**From Dean's Desk:**

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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education. Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**  
**Dean,**  
**Faculty of Technology,**  
**Member - Management Council, Senate, Academic Council**  
**University of Mumbai, Mumbai**

**Preamble:**

In the process of change in the curriculum there is a limited scope to have major changes in the fundamental subjects which are mainly part of second year of engineering. The exposure to the latest technology and tools used all over the world is given by properly selecting subjects and their hierarchy in pre-final and final year. Thus this syllabus is made to groom the undergraduate students best suited and competent in all respect with best possible efforts put in by the experts in framing detail contents of individual subjects.

The engineering education in India is expanding in manifolds and the main challenge is the quality education. All the stakeholders are very much concerned about it.

The institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation.

So the curriculum must be constantly refined and updated to ensure that the defined objectives and outcomes are achieved. Students must be encouraged to comment on the objectives and outcomes and the role played by the individual courses in achieving them. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electronics and Telecommunication Engineering University of Mumbai, happy to state here that, heads of the department and senior faculty from various institute took timely and valuable initiative to frame Program Educational Objectives as listed below.

1. To provide students with a strong foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies.
2. To prepare students to demonstrate an ability to identify, formulate and solve electronics and telecommunication engineering problems.
3. To prepare students to demonstrate ability to design electrical and electronics systems and conduct experiments, analyze and interpret data.
4. To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.
5. To develop the ability among students to synthesize data and technical concepts from applications to product design.
6. To provide opportunity for students to work as part of teams on multidisciplinary projects.
7. To promote awareness among students for the life-long learning and to introduce them to professional ethics and codes of professional practice.

These are the suggested and expected main objectives and individual affiliated institute may add further in the list. In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

The subjects offered to undergraduate students in final year are at par to the requirement of industry. The students are also made competent to appear for various competitive examination conducted in India and abroad. The subjects offered are at enough level to prepare a base of the students to understand and learn latest state of technology. The students are trained in such a way that they become versatile in hardware and software simulation. Some subjects offered upgrades them in the field of information and technology which is a need of today's' era.

At the end I must outset extend my gratitude to all experts who contributed to make curriculum competent at par with latest technological development in the field of electronics and telecommunication engineering.

**Dr. Udhav Bhosle**  
**Chairman, Board of Studies in Electronics and Telecommunication Engineering**



## Semester VII

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC701	Image and Video Processing	04	--	--	04	--	--	04
ETC702	Mobile Communication	04	--	--	04	--	--	04
ETC703	Optical Communication and Networks	04	--	-	04	--	-	04
ETC704	Microwave and Radar Engineering	04	--	--	04	--	--	04
ETE70X	Elective	04	--	--	04	--	--	04
ETL701	Image and Video Processing Laboratory	--	02	--	--	01	--	01
ETL702	Advanced communication Engineering. Laboratory I	--	02	--	--	01	--	01
ETL703	Advanced communication Engineering. Laboratory II	--	02	--	--	01	--	01
ETEL70X	Elective	--	02	--	--	01	--	01
ETP701	Project (Stage I)	--	*	--	--	03	--	03
<b>Total</b>		<b>20</b>	<b>08</b>	<b>--</b>	<b>20</b>	<b>07</b>	<b>--</b>	<b>27</b>

Course Code (ETE70X)	Sem. VII Elective
ETE 701	Data Compression and Encryption
ETE 702	Statistical Signal Processing
ETE 703	Neural Network and Fuzzy Logic
ETE 704	Analog and Mixed Signal VLSI

- Work load of learner in Semester VII is equivalent to 6 hours /week

### Semester VII

Course Code	Course Name	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Practical and Oral	Total
		Internal assessment			Ave. of Test 1 & Test 2				
		Test 1	Test 2						
ETC701	Image and Video Processing	20	20	20	80	--	--	100	
ETC702	Mobile Communication	20	20	20	80	--	--	100	
ETC703	Optical Communication and Networks	20	20	20	80	-	--	100	
ETC704	Microwave and Radar Engineering	20	20	20	80	--	--	100	
ETE70X	Elective	20	20	20	80	--	--	100	
ETL701	Image and Video Processing Laboratory	--	--	--	--	25	25	50	
ETL702	Advanced communication Engineering. Laboratory I	--	--	--	--	25	25	50	
ETL703	Advanced Communication Engineering. Laboratory II	--	--	--	--	25	25	50	
ETEL70X	Elective	--	--	--	--	25	25	50	
ETP701	Project (Stage I)					25	25	50	
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>125</b>	<b>125</b>	<b>750</b>	

### Semester VIII

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC801	Wireless Networks	04	--	--	04	--	--	04
ETC802	Satellite communication and Networks	04	--	--	04	--	--	04
ETC803	Internet and Voice Communication	04	--	--	04	--	--	04
ETE80X	Elective	04	--	--	04	--	--	04
ETL801	Wireless Networks Laboratory	--	02	--	--	01		01
ETL802	Satellite communication and Networks Laboratory	--	02	--	--	01		01
ETL803	Internet and Voice Communication Laboratory	--	02	--	--	01		01
ETEL80X	Elective Laboratory	--	02	--	--	01		01
ETP801	Project (Stage II)	--	**	--	--	06		06
<b>Total</b>		<b>16</b>	<b>08</b>	<b>--</b>	<b>16</b>	<b>10</b>		<b>26</b>

Course Code (ETE 80X)	Sem. VIII Elective
ETE 801	Speech Processing
ETE 802	Telecom Network Management
ETE 803	Microwave Integrated Circuits
ETE 804	Ultra Wideband Communication

\*\* Work load of learner in Semester VIII is equivalent to 12 hours /week.

**Semester VIII**

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical and Oral	Oral	Total
		Internal assessment								
		Test 1	Test 2	Ave. of Test 1 & Test 2						
ETC801	Wireless Networks	20	20	20	80	--	--	--	100	
ETC802	Satellite communication and Networks	20	20	20	80	--	--	--	100	
ETC803	Internet and Voice Communication	20	20	20	80	--	--	--	100	
ETE80X	Elective	20	20	20	80	--	--	--	100	
ETL801	Wireless Networks Laboratory	--	--	--	--	25	--	25	50	
ETL802	Satellite communication and Networks Laboratory	--	--	--	--	25	--	25	50	
ETL803	Internet and Voice Communication Laboratory	--	--	--	--	25	--	25	50	
ETEL80X	Elective Laboratory	--	--	--	--	25	--	25	50	
ETP801	Project (Stage II)	--	--	--	--	50	--	50	100	
<b>Total</b>		<b>80</b>	<b>80</b>	<b>80</b>	<b>320</b>	<b>150</b>		<b>150</b>	<b>700</b>	

AC-11.05.2017  
Item No. 4.210

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17  
Under

## FACULTY OF TECHNOLOGY

### **Electronics and Telecommunication Engineering**

**Second Year** with Effect from AY 2017-18

**Third Year** with Effect from AY 2018-19

**Final Year** with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**  
with effect from the AY 2016–17

**Co-ordinator, Faculty of Technology's 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 Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**  
**Co-ordinator,**  
**Faculty of Technology,**  
**Member - Academic Council**  
**University of Mumbai, Mumbai**

**Chairman's Preamble:**

The curriculum in higher education is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The engineering education in India is expanding in manifolds and the main challenge is the quality of education. All stakeholders are very much concerned about it. The curriculum of Electronics & Telecommunication in Mumbai University is no exception. In keeping with the demands of the changing times, it contains innovative features. The exposure to the latest technology and tools used all over the world is given by properly selecting the subjects. It is designed in such a way to incorporate the requirements of various industries. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of post-graduation. So the curriculum must be refined and updated to ensure that the defined objectives and outcomes are achieved.

I, as Chairman Ad-hoc Board of Studies in Electronics and Telecommunication Engineering, University of Mumbai, happy to state here that, the heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational objectives as listed below.

**Objectives:**

1. To produce Electronics & Telecommunication engineers, having strong theoretical foundation, good design experience and exposure to research and development.
2. To produce researcher who have clear thinking, articulation and interest to carry out theoretical and/or applied research resulting in significant advancement in the field of specialization.
3. To develop an ability to identify, formulate and solve electronics and telecommunication engineering problems in the latest technology.
4. To develop the ability among students to synthesize data and technical concepts from applications to product design.

These are the suggested and expected main objectives, individual affiliated institutes may add further in the list. I believe that the small step taken in the right direction will definitely help in providing quality education to the stake holders.

This book of curricula is the culmination of large number of faculty members and supporting staff. It also reflects the creative contribution of hundreds of teachers – both serving and retired. I sincerely hope that the faculty and students of Electronics and Telecommunication in Mumbai University will take full advantage of dynamic features of curriculum and make teaching-learning process a truly sublime experience for all.

At the end I must extend my gratitude to all experts and colleagues who contributed to make curriculum competent at par with latest technological development in the field of Electronics & Telecommunication Engineering.

**Dr. Uttam D. Kolekar****Chairman, Ad-hoc Board of Studies in Electronics and Telecommunication Engineering**

**Program Structure for  
B.E. Electronics & Telecommunication Engineering (Rev. 2016)  
University of Mumbai  
(With Effect from 2017-2018)**

**Semester III**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC301	Applied Mathematics- III	4	-	2@	4	1	5
ECC302	Electronic Devices and Circuits I	4	-	-	4	-	4
ECC303	Digital System Design	4	-	-	4	-	4
ECC304	Circuit Theory and Networks	4	-	2@	4	1	5
ECC305	Electronic Instrumentation and Control	4	-	2@	4	1	5
ECL301	Electronic Devices and Circuits I Laboratory	-	2	-	-	1	1
ECL302	Digital System Design Laboratory	-	2	-	-	1	1
ECL303	OOP using JAVA Laboratory	-	2	-	-	1	1
<b>Total</b>		<b>20</b>	<b>6</b>	<b>6</b>	<b>20</b>	<b>6</b>	<b>26</b>

@ 2 hour to be taken as tutorial classwise

Course Code	Course Name	Examination Scheme							Total
		Theory			End Sem Exam	Exam Duration (Hrs)	TW	Oral/ Prac	
		Internal Assessment							
		Test1	Test 2	Avg					
ECC301	Applied Mathematics-III	20	20	20	80	03	25	--	125
ECC302	Electronic Devices and Circuits I	20	20	20	80	03	--	--	100
ECC303	Digital System Design	20	20	20	80	03	--	--	100
ECC304	Circuit Theory and Networks	20	20	20	80	03	25	--	125
ECC305	Electronic Instrumentation and Control	20	20	20	80	03	25	--	125
ECL301	Electronic Devices and Circuits I Laboratory	--	--	--	--	--	25	25	50
ECL302	Digital System Design Laboratory	--	--	--	--	--	25	25	50
ECL303	OOP using JAVA Laboratory	--	--	--	--	--	25	25	50
<b>Total</b>				<b>100</b>	<b>400</b>		<b>150</b>	<b>75</b>	<b>725</b>



**Semester IV**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC401	Applied Mathematics- IV	4	-	2@	4	1	5
ECC402	Electronic Devices and Circuits II	4	-	-	4	-	4
ECC403	Linear Integrated Circuits	4	-	-	4	-	4
ECC404	Signals & Systems	4	-	2@	4	1	5
ECC405	Principles of Communication Engineering	4	-	-	4	-	4
ECL401	Electronic Devices and Circuits II Laboratory	-	2	-	-	1	1
ECL402	Linear Integrated Circuits Laboratory	-	2	-	-	1	1
ECL403	Principles of Communication Engineering Laboratory	-	2	-	-	1	1
<b>Total</b>		<b>20</b>	<b>6</b>	<b>4</b>	<b>20</b>	<b>5</b>	<b>25</b>

@ 2 hour to be taken as tutorial classwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC401	Applied Mathematics- IV	20	20	20	80	03	25	--	125
ECC402	Electronic Devices and Circuits II	20	20	20	80	03	--	--	100
ECC403	Linear Integrated Circuits	20	20	20	80	03	--	--	100
ECC404	Signals & Systems	20	20	20	80	03	25	--	125
ECC405	Principles of Communication Engineering	20	20	20	80	03	--	--	100
ECL401	Electronic Devices and Circuits II Laboratory	--	--	--	--	--	25	25	50
ECL402	Linear Integrated Circuits Laboratory	--	--	--	--	--	25	25	50
ECL403	Principles of Communication Engineering Laboratory	--	--	--	--	--	25	25	50
<b>Total</b>				<b>100</b>	<b>400</b>		<b>125</b>	<b>75</b>	<b>700</b>

**Semester V**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC501	Microprocessor & Peripherals Interfacing	4	-	-	4	-	4
ECC502	Digital Communication	4	-	-	4	-	4
ECC503	Electromagnetic Engineering	4	-	1@	4	1	5
ECC504	Discrete Time Signal Processing	4	-	-	4	-	4
ECCDLO 501X	Department Level Optional Course I	4	-	-	4	-	4
ECL501	Microprocessor & Peripherals Interfacing Lab	-	2	-	-	1	1
ECL502	Digital Communication Lab	-	2	-	-	1	1
ECL503	Business Communication & Ethics Lab	-	2+2*	-	-	2	2
ECL504	Open Source Technology for Communication Lab	-	2	-	-	1	1
ECLDLO 501X	Department Level Optional Lab I	-	-	2#	-	1	1
<b>Total</b>		<b>20</b>	<b>10</b>	<b>3</b>	<b>20</b>	<b>7</b>	<b>27</b>

@ 1 hour to be taken as tutorial classwise #2 hours to be taken as either lab or tutorial based on subject requirement  
 \*2 hours to be taken as tutorial batchwise

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	TW	Oral/Prac	Total
		Internal Assessment			Avg	80					
		Test1	Test 2	Avg							
ECC501	Microprocessor & Peripherals Interfacing	20	20	20	80	03	--	--	100		
ECC502	Digital Communication	20	20	20	80	03	--	--	100		
ECC503	Electromagnetic Engineering	20	20	20	80	03	25	--	125		
ECC504	Discrete Time Signal Processing	20	20	20	80	03	--	--	100		
ECCDLO 501X	Department Level Optional Course I	20	20	20	80	03	--	--	100		
ECL501	Microprocessor & Peripherals Interfacing Lab	--	--	--	--	--	25	25	50		
ECL502	Digital Communication Lab	--	--	--	--	--	25	25	50		
ECL503	Business Communication & Ethics Lab	--	--	--	--	--	50	--	50		
ECL504	Open Source Technology for Communication Lab	--	--	--	--	--	25	25	50		
ECLDLO 501X	Department Level Optional Lab I	--	--	--	--	--	25	--	25		
<b>Total</b>				<b>100</b>	<b>400</b>		<b>175</b>	<b>75</b>	<b>750</b>		

<b>Course Code</b>	<b>Department Level Optional Course I</b>
ECCDLO 5011	Microelectronics
ECCDLO 5012	TV & Video Engineering
ECCDLO 5013	Finite Automata Theory
ECCDLO 5014	Data Compression and Encryption

**Semester VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC601	Microcontrollers & Applications	4	-	--	4	--	4
ECC602	Computer Communication Networks	4	-	-	4	-	4
ECC603	Antenna & Radio Wave Propagation	4	-	-	4	-	4
ECC604	Image Processing and Machine Vision	4	-	--	4	--	4
ECCDLO 602X	Department Level Optional Course II	4	-	-	4	-	4
ECL601	Microcontroller & Applications Lab	-	2	-	-	1	1
ECL602	Computer Communication Network Lab	-	2	-	-	1	1
ECL603	Antenna & Radio Wave Propagation Lab	-	2	-	-	1	1
ECL604	Image Processing and Machine Vision Lab	-	2	-	-	1	1
ECLDLO 602X	Department Level Optional Lab II	-	2	-	-	1	1
<b>Total</b>		<b>20</b>	<b>10</b>	<b>-</b>	<b>20</b>	<b>5</b>	<b>25</b>

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC601	Microcontroller & Applications	20	20	20	80	03	--	--	100
ECC602	Computer Communication Network	20	20	20	80	03	--	--	100
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	03	--	--	100
ECC604	Image Processing and Machine Vision Lab	20	20	20	80	03	--	--	100
ECCDLO 602X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ECL601	Microcontroller & Applications Lab	--	--	--	--	--	25	25	50
ECL602	Computer Communication Network Lab	--	--	--	--	--	25	25	50
ECL603	Antenna & Radio Wave Propagation Lab	--	--	--	--	--	25	25	50
ECL604	Image Processing and Machine Vision Lab	--	--	--	--	--	25	25	50
ECLDLO 602X	Department Level Optional Lab II	--	--	--	--	--	25	--	25
<b>Total</b>				<b>100</b>	<b>400</b>		<b>125</b>	<b>100</b>	<b>725</b>

<b>Course Code</b>	<b>Department Level Optional Course II</b>
ECCDLO 6021	Digital VLSI Design
ECCDLO 6022	Radar Engineering
ECCDLO 6023	Database Management System
ECCDLO 6024	Audio Processing

**Semester VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC701	Microwave Engineering	4	-	-	4	-	4
ECC702	Mobile Communication System	4	-	-	4	-	4
ECC703	Optical Communication	4	-	--	4	-	4
ECCDLO 703X	Department Level Optional Course III	4	-	-	4	-	4
ILO701X	Institute Level Optional Course I	3	-	-	3	-	3
ECL701	Microwave Engineering Lab	-	2	-	-	1	1
ECL702	Mobile Communication System Lab	-	2	-	-	1	1
ECL703	Optical Communication Lab	-	2	-	-	1	1
ECLDLO 703X	Department Level Optional Lab III	-	2	-	-	1	1
ECL704	Project-I	-	6	-	-	3	3
<b>Total</b>		<b>19</b>	<b>14</b>	<b>-</b>	<b>19</b>	<b>7</b>	<b>26</b>

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC701	Microwave Engineering	20	20	20	80	03	--	--	100
ECC702	Mobile Communication System	20	20	20	80	03	--	--	100
ECC703	Optical Communication	20	20	20	80	03	--	--	100
ECCDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100
ILO701X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
ECL701	Microwave Engineering Lab	--	--	--	--	--	25	25	50
ECL702	Mobile Communication System Lab	--	--	--	--	--	25	25	50
ECL703	Optical Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 703X	Department Level Optional Lab III	--	--	--	--	--	25	25	50
ECL704	Project-I	--	--	--	--	--	50	50	100
<b>Total</b>				<b>100</b>	<b>400</b>		<b>150</b>	<b>150</b>	<b>800</b>

<b>Course Code</b>	<b>Department Level Optional Course III</b>	<b>Course Code</b>	<b>Institute Level Optional Course I<sup>#</sup></b>
ECCDLO7031	Neural Networks and Fuzzy Logic	ILO7011	Product Lifecycle Management
ECCDLO7032	Big Data Analytics	ILO7012	Reliability Engineering
ECCDLO7033	Internet Communication Engineering	ILO7013	Management Information System
ECCDLO7034	CMOS Mixed Signal VLSI	ILO7014	Design of Experiments
ECCDLO7034	Embedded System	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

**# Common with all branches**

### Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC801	RF Design	4	-	--	4	--	4
ECC802	Wireless Networks	4	-	-	4	-	4
ECCDLO 804X	Department Level Optional Course IV	4	-	-	4	-	4
ILO802X	Institute Level Optional Course II	3	-	-	3	-	3
<b>ECL801</b>	<b>RF Design Lab</b>	-	<b>2</b>	-	-	<b>1</b>	<b>1</b>
<b>ECL802</b>	<b>Wireless Networks Lab</b>	-	<b>2</b>	-	-	<b>1</b>	<b>1</b>
<b>ECLDLO 804X</b>	<b>Department Level Optional Lab IV</b>	-	<b>2</b>	-	-	<b>1</b>	<b>1</b>
<b>ECL803</b>	<b>Project-II</b>	-	<b>12</b>	-	-	<b>6</b>	<b>6</b>
<b>Total</b>		<b>15</b>	<b>18</b>	<b>-</b>	<b>15</b>	<b>9</b>	<b>24</b>

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC801	RF Design	20	20	20	80	03	--	--	100
ECC802	Wireless Networks	20	20	20	80	03	--	--	100
ECCDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100
ILO802X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
ECL801	RF Design Lab	--	--	--	--	--	25	25	50
ECL802	Wireless Networks Lab	--	--	--	--	--	25	25	50
ECLDLO 804X	Department Level Optional Lab IV	--	--	--	--	--	25	25	50
ECL803	Project-II	--	--	--	--	--	100	50	150
<b>Total</b>				<b>80</b>	<b>320</b>		<b>175</b>	<b>125</b>	<b>700</b>



# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Electronics and Telecommunication 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)

Item No. 145

AC – 23/07/2020

**UNIVERSITY OF MUMBAI****Syllabus for Approval**

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Second Year B.E. Electronics and Telecommunication Engineering</b>
2	Eligibility for Admission	<b>After Passing First Year Engineering as per the Ordinance 0.6242</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6242</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./Diploma / Certificate</b> (Strike out which is not applicable)
7	Pattern	<b>Yearly / Semester</b> (Strike out which is not applicable )
8	Status	<b>New / Revised</b> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2020-2021</b>

Date 02-07-2020

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 13 weeks and remaining 2 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 171, 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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
University of Mumbai

## Preface By BoS

Technological developments in the field of electronics and telecommunication engineering have revolutionized the way people see the world today. Hence, there is a need for continuously enriching the quality of education by a regular revision in the curriculum, which will help our students achieve better employability, start-ups, and other avenues of higher studies. The current revision in the Bachelor of Engineering program (REV- 2019 'C' Scheme) aims at providing a strong foundation with required analytical concepts in the field of electronics and telecommunication engineering.

Some of the salient features of this revised curriculum are as below and they fall in line with the features in AICTE Model Curriculum.

1. The curriculum is designed in such a way that it encourages innovation and research as the total number of credits has been reduced from around 200 credits in an earlier curriculum to 171 credits in the current revision.
2. In the second and third-year curriculum, skill-based laboratories and mini-projects are introduced.
3. It will result in the students developing a problem-solving approach and will be able to meet the challenges of the future.
4. The University of Mumbai and BoS – Electronics and Telecommunication Engineering will ensure the revision of the curriculum on regular basis in the future as well and this update will certainly help students to achieve better employability; start-ups and other avenues for higher studies.

The BoS would like to thank all the subject experts, industry representatives, alumni, and various other stakeholders for their sincere efforts and valuable time in the preparation of course contents, reviewing the contents, giving valuable suggestions, and critically analyzing the contents.

### **Board of Studies in Electronics and Telecommunication Engineering**

**Dr. Faruk Kazi: Chairman**

Dr. V. N. Pawar: Member

Dr. Ravindra Duche: Member

Dr. Milind Shah: Member

Dr. R. K. Kulkarni: Member

Dr. Baban U. Rindhe: Member

Dr. Mrs. Nair: Member

Dr. Nalbarwar: Member

Dr. Sudhakar Mande: Member

Dr. S. D. Deshmukh: 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
ECC301	Engineering Mathematics-III	3	--	1*	3	--	1	4
ECC302	Electronic Devices & Circuits	3	--	--	3	--	--	3
ECC303	Digital System Design	3	--	--	3	--	--	3
ECC304	Network Theory	3	--	1	3	--	1	4
ECC305	Electronic Instrumentation & Control Systems	3	--	--	3	--	--	3
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1
ECL302	Digital System Design Lab	--	2	--	--	1	--	1
ECL303	Electronic Instrumentation & Control Systems Lab	--	2	--	--	1	--	1
ECL304	Skill Lab: C++ and Java Programming	--	4	--	--	2	--	2
ECM301	Mini Project 1A	--	4 <sup>s</sup>	--	--	2	--	2
<b>Total</b>		<b>15</b>	<b>14</b>	<b>2</b>	<b>15</b>	<b>07</b>	<b>2</b>	<b>24</b>

\* Should be conducted batch wise.

§ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme									
		Theory					End Sem. Exam	Exam. Duration (in Hrs)	Term Work	Pract. & oral	Total
		Internal Assessment			Avg.						
		Test 1	Test 2	Avg.							
ECC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125		
ECC302	Electronic Devices & Circuits	20	20	20	80	3	--	--	100		
ECC303	Digital System Design	20	20	20	80	3	--	--	100		
ECC304	Network Theory	20	20	20	80	3	25	--	125		
ECC305	Electronic Instrumentation & Control Systems	20	20	20	80	3	--	--	100		
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	--	25	25	50		
ECL302	Digital System Design Lab	--	--	--	--	--	25	--	25		
ECL303	Electronic Instrumentation & Control Systems Lab	--	--	--	--	--	25	--	25		
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	--	25	25	50		
ECM301	Mini Project 1A	--	--	--	--	--	25	25	50		
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>75</b>	<b>750</b>		

### Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC401	Engineering Mathematics-IV	3	--	1*	3	--	1	4
ECC402	Microcontrollers	3	--	--	3	--	--	3
ECC403	Linear Integrated Circuits	3	--	--	3	--	--	3
ECC404	Signals & Systems	3	--	1	3	--	1	4
ECC405	Principles of Communication Engineering	3	--	--	3	--	--	3
ECL401	Microcontrollers Lab	--	2	--	--	1	--	1
ECL402	Linear Integrated Circuits Lab	--	2	--	--	1	--	1
ECL403	Principles of Communication Engineering Lab	--	2	--	--	1	--	1
ECL404	Skill Lab: Python Programming	--	4	--	--	2	--	2
ECM401	Mini Project 1B	--	4 <sup>s</sup>	--	--	2	--	2
<b>Total</b>		<b>15</b>	<b>14</b>	<b>2</b>	<b>15</b>	<b>7</b>	<b>2</b>	<b>24</b>

\* Should be conducted batch wise.

§ Indicates work load of a learner (Not Faculty) for Mini Project 1B. Faculty Load: 1 hour per week per four groups.

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.					
ECC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
ECC402	Microcontrollers	20	20	20	80	3	--	--	100
ECC403	Linear Integrated Circuits	20	20	20	80	3	--	--	100
ECC404	Signals & Systems	20	20	20	80	3	25	--	125
ECC405	Principles of Communication Engineering	20	20	20	80	3	--	--	100
ECL401	Microcontrollers Lab	--	--	--	--	--	25	--	25
ECL402	Linear Integrated Circuits Lab	--	--	--	--	--	25	25	50
ECL403	Principles of Communication Engineering Lab	--	--	--	--	--	25	25	50
ECL404	Skill Lab: Python Programming	--	--	--	--	--	25	25	50
ECM401	Mini Project 1B	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>175</b>	<b>100</b>	<b>775</b>

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Electronics and Telecommunication 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)



AC \_\_\_\_\_

Item No. \_\_\_\_\_

**UNIVERSITY OF MUMBAI****Syllabus for Approval**

Sr. No.	Heading	Particulars
1	Title of the Course	<b>Third Year in Bachelor of Electronics and Telecommunication Engineering</b>
2	Eligibility for Admission	<b>After Passing Second Year Engineering as per the Ordinance 0.6243</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6243</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<b>P.G. / U.G./Diploma /Certificate</b> (Strike out which is not applicable)
7	Pattern	<b>Yearly / Semester</b> (Strike out which is not applicable )
8	Status	<b>New / Revised</b> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>With effect from Academic Year: 2021-2022</b>

Date 15-05-2021

Dr. S. K. Ukarande  
Associate Dean  
Faculty of Science and Technology  
University of Mumbai

Dr Anuradha Muzumdar  
Dean  
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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 13 weeks and remaining 2 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 171, 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.

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University of Mumbai

Dr Anuradha Muzumdar  
Dean  
Faculty of Science and Technology  
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  
University of Mumbai

Dr Anuradha Muzumdar  
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## Preface By BoS

Technological developments in the field of electronics and telecommunication engineering have revolutionized the way people see the world today. Hence, there is a need for continuously enriching the quality of education by a regular revision in the curriculum, which will help our students achieve better employability, start-ups, and other avenues of higher studies. The current revision in the Bachelor of Engineering program (REV- 2019 'C' Scheme) aims at providing a strong foundation with required analytical concepts in the field of electronics and telecommunication engineering.

Some of the salient features of this revised curriculum are as below and they fall in line with the features in AICTE Model Curriculum.

1. The curriculum is designed in such a way that it encourages innovation and research as the total number of credits has been reduced from around 200 credits in an earlier curriculum to 171 credits in the current revision.
2. In the second and third-year curriculum, skill-based laboratories and mini-projects are introduced.
3. It will result in the students developing a problem-solving approach and will be able to meet the challenges of the future.
4. The University of Mumbai and BoS – Electronics and Telecommunication Engineering will ensure the revision of the curriculum on regular basis in the future as well and this update will certainly help students to achieve better employability; start-ups and other avenues for higher studies.

The BoS would like to thank all the subject experts, industry representatives, alumni, and various other stakeholders for their sincere efforts and valuable time in the preparation of course contents, reviewing the contents, giving valuable suggestions, and critically analyzing the contents.

### **Board of Studies in Electronics and Telecommunication Engineering**

**Dr. Faruk Kazi: Chairman**

Dr. V. N. Pawar: Member

Dr. Ravindra Duche: Member

Dr. Milind Shah: Member

Dr. R. K. Kulkarni: Member

Dr. Baban U. Rindhe: Member

Dr. Mrs. Nair: Member

Dr. Nalbarwar: Member

Dr. Sudhakar Mande: Member

Dr. S. D. Deshmukh: Member

**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.	Tut.	Theory	Pract.	Tut.	Total
ECC501	Digital Communication	3	--	--	3	--	--	3
ECC502	Discrete Time Signal Processing	3	--	--	3	--	--	3
ECC503	Digital VLSI	3	--	--	3	--	--	3
ECC504	Random Signal Analysis	3	--	1	3	--	1	4
ECCDLO 501X	Department Optional Course-1	3	--	--	3	--	--	3
ECL501	Digital Communication Lab	--	2	--	--	1	--	1
ECL502	Discrete Time Signal Processing Lab	--	2	--	--	1	--	1
ECL503	Digital VLSI Lab	--	2	--	--	1	--	1
ECL504	Professional Communication & Ethics - II	--	2*+2~	--	--	2	--	2
ECM501	Mini Project 2A- Embedded System Project	--	4\$	--	--	2	--	2
<b>Total</b>		<b>15</b>	<b>14</b>	<b>1</b>	<b>15</b>	<b>07</b>	<b>1</b>	<b>23</b>

\* Theory should be conducted for the full class.

~ Batch-wise practical's to be conducted

\$ Indicates work load of a learner (Not Faculty) for Mini Project 2A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme							Total
		Theory					Term Work	Pract. & oral	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ECC501	Digital Communication	20	20	20	80	3	--	--	100
ECC502	Discrete Time Signal Processing	20	20	20	80	3	--	--	100
ECC503	Digital VLSI	20	20	20	80	3	--	--	100
ECC504	Random Signal Analysis	20	20	20	80	3	25	--	125
ECCDLO 501X	Department Level Optional Course-1	20	20	20	80	3	--	--	100
ECL501	Digital Communication Lab	--	--	--	--	--	25	25	50
ECL502	Discrete Time Signal Processing Lab	--	--	--	--	--	25	25	50
ECL503	Digital VLSI Lab	--	--	--	--	--	25	25	50
ECL504	Business Communication and Ethics Lab	--	--	--	--	--	25	25	50
ECM501	Mini Project 2A- Embedded System Project	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>150</b>	<b>125</b>	<b>775</b>

**Program Structure for  
First Year Engineering (Semester I & II)  
Mumbai University  
(With Effect from 2016-2017)**

**Semester I**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total	
FEC101	Applied Mathematics-I	04	-	01	04	-	01	05	
FEC102	Applied Physics-I	03	01	-	03	0.5	-	3.5	
FEC103	Applied Chemistry -I	03	01	-	03	0.5	-	3.5	
FEC104	Engineering Mechanics	05	02	-	05	01	-	06	
FEC105	Basic Electrical Engineering	04	02	-	04	01	-	05	
FEC106	Environmental studies	02	-	-	02	-	-	02	
FEL101	Basic Workshop Practice-I	-	04	-	-	02	-	02	
<b>Total</b>		<b>21</b>	<b>10</b>	<b>01</b>	<b>21</b>	<b>05</b>	<b>01</b>	<b>27</b>	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg					
FEC101	Applied Mathematics-I	20	20	20	80	25	-	-	125
FEC102	Applied Physics-I	15	15	15	60	25	-	-	100
FEC103	Applied Chemistry -I	15	15	15	60	25	-	-	100
FEC104	Engineering Mechanics	20	20	20	80	25	-	25	150
FEC105	Basic Electrical Engineering	20	20	20	80	25	-	25	150
FEC106	Environmental studies	15	15	15	60	-	-	-	75
FEL101	Basic Workshop Practice-I	-	-	-	-	50	-	-	50
<b>Total</b>				<b>105</b>	<b>420</b>	<b>175</b>		<b>50</b>	<b>750</b>

**First Year Engineering (Semester I & II), Revised course from Academic Year 2016-17,  
(REV- 2016) (Common for all Branches of Engineering)**

**Scheme for FE - Semester – II**

Sub. Code	Subject Name	Examination Scheme							Total	
		Theory marks				End sem. exam	Term Work	Pract.		Oral
		Internal Assessment								
		Test 1	Test 2	Average of Test 1 & Test 2						
FEC201	Applied Mathematics-II	20	20	20	80	25	-	-	125	
FEC202	Applied Physics-II	15	15	15	60	25	-	-	100	
FEC203	Applied Chemistry -II	15	15	15	60	25	-	-	100	
FEC204	Engineering Drawing	15	15	15	60	25	50	-	150	
FEC205	Structured Programming Approach	20	20	20	80	25	25	-	150	
FEC206	Communication Skills	10	10	10	40	25	-	-	75	
FEL201	Basic Workshop Practice-II	-	-	-	-	50	-	-	50	
				95	380	200	75		750	

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC201	Applied Mathematics-II	04	-	01	04		01	05
FEC202	Applied Physics-II	03	01	-	03	0.5	-	3.5
FEC203	Applied Chemistry -II	03	01	-	03	0.5		3.5
FEC204	Engineering Drawing	03	04	-	03	02	-	05
FEC205	Structured Programming Approach	04	02	-	04	01	-	05
FEC206	Communication Skills	02	02	-	02	01	-	03
FEL201	Basic Workshop Practice -II	-	04	-	-	02	-	02
		19	14	01	19	07	01	27

**Program Structure for First Year Engineering  
Semester I & II  
UNIVERSITY OF MUMBAI  
(With Effect from 2019-2020)**

**Semester I**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
FEC101	Engineering Mathematics-I	3	--	1*	3	--	1	4	
FEC102	Engineering Physics-I	2	--	--	2	--	--	2	
FEC103	Engineering Chemistry-I	2	--	--	2	--	--	2	
FEC104	Engineering Mechanics	3	--	--	3	--	--	3	
FEC105	Basic Electrical Engineering	3	--	--	3	--	--	3	
FEL101	Engineering Physics-I	--	1	--	--	0.5	--	0.5	
FEL102	Engineering Chemistry-I	--	1	--	--	0.5	--	0.5	
FEL103	Engineering Mechanics	--	2	--	--	1	--	1	
FEL104	Basic Electrical Engineering	--	2	--	--	1	--	1	
FEL105	Basic Workshop practice-I	--	2	--	--	1	--	1	
<b>Total</b>		<b>13</b>	<b>08</b>	<b>01</b>	<b>13</b>	<b>04</b>	<b>01</b>	<b>18</b>	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC101	Engineering Mathematics-I	20	20	20	80	3	25	--	125
FEC102	Engineering Physics-I	15	15	15	60	2	--	--	75
FEC103	Engineering Chemistry-I	15	15	15	60	2	--	--	75
FEC104	Engineering Mechanics	20	20	20	80	3	--	--	100
FEC105	Basic Electrical Engineering	20	20	20	80	3	--	--	100
FEL101	Engineering Physics-I	--	--	--	--	--	25	--	25
FEL102	Engineering Chemistry-I	--	--	--	--	--	25	--	25
FEL103	Engineering Mechanics	--	--	--	--	--	25	25	50
FEL104	Basic Electrical Engineering	--	--	--	--	--	25	25	50
FEL105	Basic Workshop practice-I	--	--	--	--	--	50	--	50
<b>Total</b>		--	--	<b>90</b>	<b>360</b>	--	<b>175</b>	<b>50</b>	<b>675</b>

\* May be conducted batch-wise



**Semester II**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
FEC201	Engineering Mathematics-II	3	--	1*	3	--	1	4	
FEC202	Engineering Physics-II	2	--	--	2	--	--	2	
FEC203	Engineering Chemistry-II	2	--	--	2	--	--	2	
FEC204	Engineering Graphics	2	--	--	2	--	--	2	
FEC205	C programming	2	--	--	2	--	--	2	
FEC206	Professional Communication and Ethics- I	2	--	--	2	--	--	2	
FEL201	Engineering Physics-II	--	1	--	--	0.5	--	0.5	
FEL202	Engineering Chemistry-II	--	1	--	--	0.5	--	0.5	
FEL203	Engineering Graphics	--	4	--	--	2	--	2	
FEL204	C programming	--	2	--	--	1	--	1	
FEL205	Professional Communication and Ethics- I	--	2	--	--	1	--	1	
FEL206	Basic Workshop practice-II	--	2	--	--	1	--	1	
<b>Total</b>		<b>13</b>	<b>12</b>	<b>01</b>	<b>13</b>	<b>06</b>	<b>01</b>	<b>20</b>	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC201	Engineering Mathematics-II	20	20	20	80	3	25	--	125
FEC202	Engineering Physics-II	15	15	15	60	2	--	--	75
FEC203	Engineering Chemistry-II	15	15	15	60	2	--	--	75
FEC204	Engineering Graphics	15	15	15	60	3	--	--	75
FEC205	C programming	15	15	15	60	2	--	--	75
FEC206	Professional Communication and Ethics- I	10	10	10	40	2	--	--	50
FEL201	Engineering Physics-II	--	--	--	--	--	25	--	25
FEL202	Engineering Chemistry-II	--	--	--	--	--	25	--	25
FEL203	Engineering Graphics	--	--	--	--	--	25	50	75
FEL204	C programming	--	--	--	--	--	25	25	50
FEL205	Professional Communication and Ethics- I	--	--	--	--	--	25	--	25
FEL206	Basic Workshop practice-II	--	--	--	--	--	50	--	50
<b>Total</b>		--	--	<b>90</b>	<b>360</b>	--	<b>200</b>	<b>75</b>	<b>725</b>

\* May be conducted batch-wise