



No. UG/ 65 of 2019-20

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/131 of 2016-17 dated 9th November, 2016 relating to the revised syllabus as per (CBCS) for Bachelor of Engineering (First Year Engineering (Sem. I to II).

They are hereby informed that the recommendations made by the faculty members of Engineering at its meeting held on 8th May, 2019 have been accepted by the Academic Council at its meeting held on 26th July, 2019 vide item No. 4.40 and that in accordance therewith, the Revised Syllabus and Scheme for 2019 of **First Year Engineering** (Sem. I & II) as per AICTE model curriculum from the academic year 2019-20. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

14th August, 2019

To

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

A.C/4.40/26/07/2019

No. UG/ 65 -A of 2019-20

MUMBAI-400 032

14th August, 2019

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Director, Board of Examinations and Evaluation,
- 3) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,

(Dr. Ajay Deshmukh)
REGISTRAR

UNIVERSITY OF MUMBAI



Bachelor of Engineering

First Year Engineering (Semester I & II), Revised course

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

(Common for All Branches of Engineering)

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 in the present system, the first year syllabus is heavily loaded and it is of utmost importance that the students entering into the first year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a student to get accustomed to the new environment of a college and to create a bonding between the teacher and a student. In this regard, AICTE has provided a model of Induction Program, which has been accommodated with certain modification and also overall credits proposed by AICTE in their model curriculum.

The present curriculum will be implemented for First Year of Engineering from the academic year 2019-20. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2020-21, for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. Suresh K. Ukarande
Dean (I/C)
Faculty of Science and Technology
Member, Senate Academic Council
Board of Dean's, BOEE, RRC
University of Mumbai, Mumbai

Structure for Student Induction Program

New students enter an institution with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Transition from school to university/college life is one of the most challenging events in student's life. Therefore, it should be taken seriously, and as something more than the mere orientation program.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

New students be informed that the Induction is mandatory non-credit course for which a certificate will be issued by the institution.

At the start of the induction, the incumbents learn about the institutional policies, processes, practices, culture and values, and their mentor groups are formed. The different activities are:

1. **Orientation:** In the first session of Induction program learners and parents to be oriented about institute policies, processes, practices, culture and values. In addition to this, learners will be educated for 1st year academic program information in terms of academic calendar, Assessment plan, grading information, university ordinances, rules and regulations related to academics.
2. **Mentoring:** Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring process shall be carried out in small groups, group of 10 students to be formed and allocate one senior student from 3rd year of same program in which new students have taken admission, students mentor will continue for two years, till student mentors graduate from the institute. For two (2) such groups one faculty mentor to be allocated from the same department/program, who will remain the mentor till those students graduates from the institute. In the second session of Induction program, groups for mentoring to be formed and student mentors and faculty mentors to be introduced to newly inducted students. Introduction of mentoring system to be given to new students. Minimum one meeting to be

conducted every month during semesters with students group by faculty mentors. For record keeping appropriate formats to be developed and information to be updated regularly by faculty mentors.

- 3. Universal Human Values:** Universal Human Values gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and don't's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.
- 4. Proficiency Modules:** The induction program period can be used to overcome some critical lacunas that students might have, for example, English, Mathematics, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially.

A diagnostic test should be conducted on Day 2 itself. Before the test, the students should be informed that the test would not affect their grades, branch change, or any aspect of their admission, placement, study, etc. Purpose of the test is to provide help to those students who need help in English, Mathematics, Computer proficiency etc. Students having more than 80% marks in their qualifying examination in respective subjects need not take the diagnostic test. For those below this cut-off, writing the test is mandatory. Students with weak performance in the test, must attend a non-credit course in Basic English, Basic Mathematics, and Basic Computer Operation etc. Their attending the course is mandatory. There would be no separate fee payable for the course. The classes of Basic courses must start from Day 4 at the latest. Students those who are excluded from basic courses, for them some activity in the domain of creative arts, cultural and literature to be organised.

- 5. Physical Activity:** Fitness session, yoga classes, lecture(s) on facing world with sportsman spirit, making young students aware that there is nothing like being failure in the world. The world gives opportunities to all.

The incoming students must be divided into batches of 50 students maximum, and a qualified coach in physical education/ faculty member should be attached to each batch. The list of available games, sport, or physical activities should be announced in orientation program on Day 1. They should be asked to fill their choice with three preferences, and the game or sport be allotted to them as per their preference. The physical activity should start from Day 3 onwards, wherein the student learns and plays his assigned game during the induction program. It is also important that along with his assigned game the student also practises yoga.

6. **Creative Arts, Cultural and Literary Activity:** Qualified instructors for arts may be hired on contract basis and be paid honorarium as per norms of the institute. Daily 90 to 120 minute sessions may be arranged. The list of available art forms, such as vocal music, instrumental music, folk music, painting, sketching, dance, group dance, clay modelling, pottery, dramatics, etc. should be announced. They should be asked to fill their choice with three preferences, and the art form be allotted to them as per their preference. There should be sufficient number of teachers for each art form. The ratio may be kept as 1 teacher for every 25 students.

A faculty member interested in literary activity should be assigned for organizing the activity. A list of books which are interesting and educational should be prepared beforehand. Books in Indian languages must be included and even given priority. Students are losing connection with languages in general and their own language, in particular. Students should be assigned a book or other smaller reading material. They should be asked to read and write a critical summary. They should present their summary in front of their group. A literary group may consist of around 30-40 students. Similarly, debating and public speaking activity could also be undertaken. If the college can arrange for a drama workshop where a group of students learn and enact a play it would be very good. Not all the incoming students would do this, but those who wish may be provided the opportunity. Help may be taken from senior students engaged in such extra-curricular activities in the college.

7. **Familiarisation with Institute and Department:** The students admitted in a branch would visit their allotted department or branch. The Head of the department and other associated faculty should address the new student's right on Day 2 or so. Arrangements should be made about the meeting/gathering. The parents of the students should also be welcomed if they accompany their ward. It would be helpful if an alumnus of the Dept. relates his professional experience related to the field of the study to the incoming students.
8. **Lectures /Workshops by Eminent People:** Eminent people from all walks of life may be invited to deliver lectures, namely, from industry, academia, social science (authors, historians), social work, civil society, alumni etc. be identified and invited to come and address the new students. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, S-VYASA university, VivekanandKendras, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops.
9. **Extra-Curricular Activity:** Every college has extra-curricular activities. Most of them are student driven. They are organized by student councils and clubs. The extra-curricular activities going on in the college should be presented to the new students under the guidance of faculty advisors for such activity. The new students should be informed about how they can join the activities. Related facilities should be described to them. Presentation on the activities by the student council should be made.

10. Feedback and Report on the Program: A formal feedback at the end of the program should be collected from students by their filling a form in writing or online. Besides the above, each group (of 20 students) should write a report on the Induction Program towards the end of the semester. They would also have to make a presentation of their report. They should be encouraged to use slides while making a presentation. Presentation of the report should be made in the language they are comfortable with, without any insistence that it should be in English. It is more important that they feel comfortable and confident. Each group may make the presentation through 4-5 of its group members or more. In case, the number of new students in a college is large, the presentation should be made by each group in front of 4 other groups besides their own, thus there would be about 100 students (in 5 groups) in the audience in a session. Several such sessions could run in parallel or serially. In each session, their faculty mentors and student guides, if any, should also be in the audience. These sessions would tell you how well the program ran, and what the students are feeling at the end of the program. This would also serve as a grand closure to the program.

A certificate shall be awarded to all the students, upon successful completion of the induction program based on their report and presentation.

Tentative schedule of 1st Week Induction Program:

Day 1	Session 1	Orientation program
	Session 2	Mentoring (group formation and introduction)
Day 2	Session 3	Diagnostic test (basic English, maths and computer operation)
	Session 4	Familiarisation of Department and Institute (Visits to department, laboratory, Library, Examination cell, office etc)
Day 3	Session 5	Physical Activity (Yoga, sports etc)
	Session 6	Universal human values session
Day 4	Session 7	Proficiency Modules (Short courses on basic maths, English and computer operation etc. for identified students)
	Session 8	Physical Activity (Yoga, sports etc)
Day 5	Session 9	Proficiency Modules (Short courses on basic maths, English and computer operation etc. for identified students)
	Session 10	Creative Arts, Cultural and Literary Activity

A session may be conducted for around 2-3 hours each.

Minimum 12 sessions to be conducted from the following 20 sessions, from 2nd week to last week of academics, throughout the semester.

Session 11	Physical Activity (Yoga, sports etc)- 1
Session 12	Extra-Curricular Activity- 1
Session 13	Physical Activity (Yoga, sports etc)-2
Session 14	Extra-Curricular Activity- 2
Session 15	Physical Activity (Yoga, sports etc)- 3
Session 16	Lectures /Workshops by Eminent People- 1
Session 17	Physical Activity (Yoga, sports etc)- 4
Session 18	Lectures /Workshops by Eminent People- 2
Session 19	Creative Arts, Cultural and Literary Activity- 1
Session 20	Lectures /Workshops by Eminent People- 3
Session 21	Creative Arts, Cultural and Literary Activity- 2
Session 22	Universal Human Values- 1(Group Discussion among students as per mentoring group on various aspects of life, values, ethics etc.)
Session 23	Creative Arts, Cultural and Literary Activity- 3
Session 24	Universal Human Values- 2 (Group Discussion among students as per mentoring group on various aspects of life, values, ethics etc.)
Session 25	Creative Arts, Cultural and Literary Activity- 4
Session 26	Universal Human Values- 3 (Group Discussion among students as per mentoring group on various aspects of life, values, ethics etc.)
Session 27	Creative Arts, Cultural and Literary Activity- 5
Session 28	Physical Activity (Yoga, sports etc)- 5
Session 29	Feedback and Report on the Program- 1
Session 30	Feedback and Report on the Program- 2

For mentoring activity following 4 page format (may be printed as booklet) be adopted by institute for keeping record in detail of students during 4 year tenure by faculty mentor.

NAME OF INSTITUTE

LOGO OF INSTITUTE

Student Mentoring Form

Student's Personal Details	
Name :	Roll No:
Date of Birth:	Male/Female:
Current Address:	
Permanent Address:	
Mobile No:	Email Id:
Father's Name:	
Mobile No.:	Email ID.:
Mother's Name	
Mobile No.:	Email ID.:
Name of The Student Mentor:	
Mobile No.:	Email ID.:
Name of The Faculty Mentor:	
Designation:	Department.:

Student's Attendance Record

Semester	Month / Year :		Month / Year :		Month / Year :	
	Percentage	Signature	Percentage	Signature	Percentage	Signature
I						
II						
III						
IV						
V						
VI						
VII						
VIII						

Student's Academic Performance

Semester	Subject	IA1		IA 2		Prelim		End semester Exam (SGPI)		Signature
		C	N/C	C	N/C	C	N/C	C	N/C	
I	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
II	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
III	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
IV	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
V	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
VI	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
VII	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
VIII	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									

Note.:

1. C - Cleared, write percentage or SGPI in Remarks.
2. N/C - write subjects not cleared in Remarks.
3. If students cleared subjects in next academic year kindly circle "N/C" and click On "C"

Student's Co-curricular Activities

Semester	Professional Society	Internship	Papers Published
I			
II			
III			
IV			
V			
VI			
VII			
VIII			

Student Mentor's Feedback Semester wise

Semester I	Semester II	Semester III	Semester IV

Student's Extra-Curricular Activities

Semester	Sports	NSS / Social cell	Competition / Participation / Prize / Awards
I			
II			
III			
IV			
V			
VI			
VII			
VIII			

Placement: - Yes / No If yes get following Details:

Company :-
Package :-

Higher Studies.

Exams	GRE	TOFEL	CAT	GATE
SCORE				

If Admitted:-

University :-
Country :-

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	
Total		13	08	01	13	04	01	18	
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
Total		--	--	90	360	--	175	50	675

* Shall 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	
Total		13	12	01	13	06	01	20	
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
Total		--	--	90	360	--	200	75	725

* Shall be conducted batch-wise

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC201	Engineering Mathematics-I	3	--	1*	3	1	--	4	
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-I	20	20	20	80	3	25	--	125

Course Objectives: The course is aimed

1. to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology.
2. to provide hands on experience using SCILAB software to handle real life problems.

Course Outcomes: Students will be able to

1. Apply the basic concepts of Complex Numbers and will be able to use it for engineering problems.
2. Apply hyperbolic functions and logarithms in the subjects like electrical circuits, Electromagnetic wave theory.
3. Apply the basic concepts of partial differentiation of function of several variables and will be able to use in subjects like Electromagnetic Theory, Heat and Mass Transfer etc.
4. Apply the concept of Maxima, Minima and Successive differentiation and will be able to use it for optimization and tuning the systems.
5. Apply the concept of Matrices and will be able to use it for solving the KVL and KCL in electrical networks.
6. Apply the concept of Numerical Methods for solving the engineering problems with the help of SCILAB software.

Module	Detailed Contents	Hrs.
01	Complex Numbers	
	Pre-requisite: Review of Complex Numbers-Algebra of Complex Number, Cartesian, polar and exponential form of complex number.	
	1.1. Statement of D'Moivre's Theorem .	2
	1.2. Expansion of $\sin^n\theta$, $\cos^n\theta$ in terms of sines and cosines of multiples of θ and Expansion of $\sin n\theta$, $\cos n\theta$ in powers of $\sin\theta$, $\cos\theta$	2
	1.3. Powers and Roots of complex number.	2
02	Hyperbolic function and Logarithm of Complex Numbers	
	2.1. Circular functions of complex number and Hyperbolic functions. Inverse Circular and Inverse Hyperbolic functions. Separation of real and imaginary parts of all types of Functions.	4
	2.2 Logarithmic functions, Separation of real and Imaginary parts of Logarithmic Functions.	2
	# Self learning topics: Applications of complex number in Electrical circuits.	

03	<p>Partial Differentiation 3.1 Partial Differentiation: Function of several variables, Partial derivatives of first and higher order. Differentiation of composite function. 3.2. Euler's Theorem on Homogeneous functions with two independent variables (with proof). Deductions from Euler's Theorem.</p> <p># Self learning topics: Total differentials, implicit functions, Euler's Theorem on Homogeneous functions with three independent variables.</p>	3 3
04	<p>Applications of Partial Differentiation and Successive differentiation.</p> <p>4.1 Maxima and Minima of a function of two independent variables, Lagrange's method of undetermined multipliers with one constraint. 4.2 Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems</p> <p># Self learning topics: Jacobian's of two and three independent variables (simple problems)</p>	3 3
05	<p>Matrices Pre-requisite: Inverse of a matrix, addition, multiplication and transpose of a matrix</p> <p>5.1. Types of Matrices (symmetric, skew-symmetric, Hermitian, Skew Hermitian, Unitary, Orthogonal Matrices and properties of Matrices). Rank of a Matrix using Echelon forms, reduction to normal form and PAQ form. 5.2. System of homogeneous and non-homogeneous equations, their consistency and solutions.</p> <p># Self learning topics: Application of inverse of a matrix to coding theory.</p>	4 2
06	<p>Numerical Solutions of Transcendental Equations and System of Linear Equations and Expansion of Function.</p> <p>6.1 Solution of Transcendental Equations: Solution by Newton Raphson method and Regula-Falsi method. 6.2 Solution of system of linear algebraic equations, by (1) Gauss Jacobi Iteration Method, (2) Gauss Seidal Iteration Method. 6.3 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only). Expansion of e^x, $\sin(x)$, $\cos(x)$, $\tan(x)$, $\sinh(x)$, $\cosh(x)$, $\tanh(x)$, $\log(1+x)$, $\sin^{-1}(x)$, $\cos^{-1}(x)$, $\tan^{-1}(x)$.</p> <p># Self learning topics: Indeterminate forms, L-Hospital Rule, Gauss Elimination Method, Gauss Jordan Method.</p>	2 2 2

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write at least 4 SCILAB tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SCILAB Tutorials will be based on (i) Gauss Elimination Method (ii) Gauss Seidal Iteration method (iii) Gauss Jacobi Iteration Method (iv) Newton Raphson Method (v) Regula-Falsi method (vi) Maxima and Minima of functions of two variables

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.	SCILAB Tutorials	10 marks

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 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 9thEd.
3. Engineering Mathematics by Srimanta Pal and Subodh,C.Bhunia, Oxford University Press
4. Matrices, Shanti Narayan, .S. Chand publication.
5. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGraw Hill
6. Elementary Linear Algebra with Application by Howard Anton and Christ Rorres. 6th edition. John Wiley & Sons,INC.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC102	Engineering Physics-I	2	-	-	2	-	-	2	
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.					
FEC102	Engineering Physics-I	15	15	15	60	2	--	--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai.

The topic distribution is being done in systematic manner and whenever required, prerequisite to the topic are mentioned for frictionless teaching–learning process. In the distribution of topics, core physics and its applied form are given priority. At the same time few modules are introduced over emerging trends in the field of technology.

For the purpose of emphasis on applied part, list of suggestive experiments is added. As per new guidelines of AICTE, a scope is kept in the syllabus for simulation technique and use of information technology to supplement laboratory practices. Further, it is ensured that these modules will cover prerequisites needed for engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects in respective branches.

Objectives

1. To understand basic physics concepts and founding principles of technology.
2. To develop scientific temperament for scientific observations, recording, and inference drawing essential for technology studies.

Outcomes: Learners will be able to...

1. Illustrate the fundamentals of quantum mechanics and its application.
2. Explain peculiar properties of crystal structure and apply them in crystallography using X-ray diffraction techniques.
3. Comprehend the concepts of semiconductor physics and applications of semiconductors in electronic devices.
4. Employ the concept of interference in thin films in measurements.
5. Discuss the properties of Superconductors and Supercapacitors to apply them in novel applications.
6. Compare the properties of engineering materials for their current and futuristic frontier applications.

Module	Detailed Contents	Hrs.
01	QUANTUM PHYSICS (Prerequisites : Dual nature of radiation, Photoelectric effect Matter waves-wave nature of particles, de-Broglie relation, Davisson-Germer experiment)	07

	De Broglie hypothesis of matter waves; properties of matter waves; wave packet, phase velocity and group velocity; Wave function; Physical interpretation of wave function; Heisenberg uncertainty principle; non existence of electron in nucleus; Schrodinger's time dependent wave equation; time independent wave equation; Particle trapped in one dimensional infinite potential well, Quantum Computing.	
02	<p>CRYSTALLOGRAPHY (Prerequisites : Crystal Physics (Unit cell, Space lattice, Crystal structure, Simple Cubic, Body Centered Cubic, Face Centered Cubic, Diamond Structure, Production of X-rays) Miller indices; interplanar spacing; X-ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer;</p>	03
03	<p>SEMICONDUCTOR PHYSICS (Prerequisites: Intrinsic and extrinsic semiconductors, Energy bands in conductors, semiconductors and insulators, Semiconductor diode, I-V characteristics in forward and reverse bias) Direct & indirect band gap semiconductor; Fermi level; Fermi dirac distribution; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; mobility, current density; Hall Effect; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias); Applications of semiconductors: LED, Zener diode, Photovoltaic cell.</p>	06
04	<p>INTERFERENCE IN THIN FILM (Prerequisites : Wave front and Huygen's principle, reflection and refraction, Interference by division of wave front, Youngs double slit experiment) Interference by division of amplitude, Interference in thin film of constant thickness due to reflected and transmitted light; origin of colours in thin film; Wedge shaped film; Newton's rings. Applications of interference - Determination of thickness of very thin wire or foil; determination of refractive index of liquid; wavelength of incident light; radius of curvature of lens; testing of surface flatness; Anti-reflecting films and Highly reflecting film.</p>	06
05	<p>SUPERCONDUCTORS AND SUPERCAPACITORS (Prerequisites : Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current, Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical resistivity and conductivity temperature dependence of resistance) Superconductors: Critical temperature, critical magnetic field, Meissner's effect, Type I and Type II and high Tc superconductors; Supercapacitors: Principle, construction, materials and applications, comparison with capacitor and batteries : Energy density, Power density,</p>	02
06	<p>ENGINEERING MATERIALS AND APPLICATIONS (Prerequisites: Paramagnetic materials, diamagnetic materials, ferromagnetic materials, crystal physics, Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance) Liquid crystals: Nematic, Smectic and cholesteric phases, Liquid crystal display. Multiferroics : Type I & Type II multiferroics and applications,</p>	02

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. A text book of Engineering Physics-Avadhanulu&Kshirsagar, S. Chand
2. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
3. Fundamentals of optics by Jenkins and White, McGrawHill
4. Solid State Electronic Devices- B. G. Streetman, Prentice Hall Publisher
5. Modern Engineering Physics – Vasudeva, S.Chand
6. Concepts of Modern Physics- ArtherBeiser, Tata McGraw Hill
7. A Text Book of Engineering Physics, S. O. Pillai, New Age International Publishers.
8. Introduction to Solid State Physics- C. Kittel, John Wiley& Sons publisher
9. Ultracapacitors: The future of energy storage- R.P Deshpande, McGraw Hill
10. Advanced functional materials – AshutoshTiwari, LokmanUzun, Scrivener Publishing LLC.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC103	Engineering Chemistry-I	02	-	-	02	-	-	2	
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.					
FEC103	Engineering Chemistry-I	15	15	15	60	2	--	--	75

Objectives

- The concepts developed in this course will aid in quantification as well as understand the applications of several concepts in Chemistry that have been introduced at the 10 + 2 levels in schools.

Outcomes: Learners will be able to...

- Explain the concept of microscopic chemistry in terms of atomic and molecular orbital theory and relate it to diatomic molecules.
- Describe the concept of aromaticity and interpret it with relation to specific aromatic systems.
- Illustrate the knowledge of various types of intermolecular forces and relate it to real gases.
- Interpret various phase transformations using thermodynamics.
- Illustrate the knowledge of polymers, fabrication methods, conducting polymers in various industrial fields.
- Analyze the quality of water and suggest suitable methods of treatment.

Module	Detailed Contents	Hrs.
01	Atomic and Molecular Structure Atomic orbitals (s,p,d,f) orbital shapes, Electronic Configuration, Molecular orbital theory (MOT), bonding and anti-bonding orbitals, Molecular orbital diagrams of Homonuclear and Heteronuclear diatomic molecules-Be ₂ , O ₂ , CO, NO their bond order and magnetic properties,	04
02	Aromatic systems & their molecular structure Define Aromaticity, Huckel's rule, Structure and bonding of benzene and pyrrole.	02
03	Intermolecular Forces & Critical Phenomena Ionic, dipolar and Vander Waal's interactions, Equations of state of real gases and critical phenomena	03
04	Phase Rule-Gibb's Phase Rule Statement of Gibbs' Phase Rule, Terms involved with examples, One Component System (Water), Reduced Phase Rule, Two Component System (Pb- Ag), Advantages and Limitations of Phase Rule. Numerical problems on Phase Rule.	05

05	<p>Polymers</p> <p>Introduction: Definition- Polymer, polymerization, Properties of Polymers- Molecular weight (Number average and Weight average), Numerical problems on molecular weight, effect of heat on polymers (glass transition temperature), Viscoelasticity, Conducting Polymers, Classification- Thermoplastic and Thermosetting polymers; Compounding of plastic, Fabrication of plastic by Compression, Injection, Transfer and Extrusion moulding, Preparation, properties and uses of PMMA and Kevlar.</p>	05
06	<p>Water</p> <p>Introduction - Impurities in water, hardness of water- units (no conversions), types and numerical problems, determination of hardness of water by EDTA method and numerical problems. Softening of water by Ion Exchange process and numerical problems, BOD, COD- definition, significance and Numerical problems. Water purification- membrane technology- Electrodialysis, Reverse osmosis, and Ultra filtration.</p>	05

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. Engineering Chemistry - Jain & Jain (DhanpatRai)
2. Engineering Chemistry – Dara & Dara (S Chand)
3. Engineering Chemistry - Wiley India (ISBN – 9788126519880)
4. A Text Book of Engineering Chemistry – ShashiChawla (DhanpatRai)
5. Engineering Chemistry – Payal Joshi & Shashank Deep (Oxford University Press)
6. Concise Inorganic Chemistry – J D LEE
7. Essentials of Physical Chemistry—B S Bahl Arun Bahl G D Tuli.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC104	Engineering Mechanics	3	--	--	3	--	--	3	
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.					
FEC104	Engineering Mechanics	20	20	20	80	3	--	--	100

Objectives

1. To familiarize the concept of equilibrium and friction
2. To study and analyze motion of moving particles/bodies.

Outcomes: Learners will be able to...

1. Illustrate the concept of force, moment and apply the same along with the concept of equilibrium in two and three dimensional systems with the help of FBD.
2. Demonstrate the understanding of Centroid and its significance and locate the same.
3. Correlate real life application to specific type of friction and estimate required force to overcome friction.
4. Establish relation between velocity and acceleration of a particle and analyze the motion by plotting the relation
5. Illustrate different types of motions and establish Kinematic relations for a rigid body
6. Analyze particles in motion using force and acceleration, work-energy and impulse-momentum principles

Self-Study/pre-requisites Topics:

Resolution of a forces. Use of trigonometry functions. Parallelogram law of forces. Law of triangle. Polygon law of forces, Lami's theorem. Concepts of Vector Algebra.

Uniformly accelerated motion along straight line, motion under gravity, projectile motion, Time of flight, Horizontal range, Maximum height of a projectile.

Law of conservation of Energy, Law of conservation of Momentum, Collision of Elastic Bodies.

Module	Detailed Contents	Hrs.
01	1.1 System of Coplanar Forces: Classification of force systems, Principle of transmissibility, composition and resolution of forces.	06
	1.2 Resultant: Resultant of coplanar and Non Coplanar (Space Force) force system (Concurrent forces, parallel forces and non-concurrent Non-parallel system of forces). Moment of force about a point, Couples, Varignon's Theorem. Force couple system. Distributed Forces in plane.	
	Centroid: First moment of Area, Centroid of composite plane Laminas	03

02	2.1 Equilibrium of System of Coplanar Forces: Conditions of equilibrium for concurrent forces, parallel forces and non-concurrent non-parallel general forces and Couples. Equilibrium of rigid bodies-free body diagrams.	04
	2.2 Equilibrium of Beams: Types of beams, simple and compound beams, type of supports and reaction: Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges)	03
03	Friction: Revision of Static Friction, Dynamic/ Kinetic Friction, Coefficient of Friction, Angle of Friction, Laws of friction. Concept of Cone of friction. Equilibrium of bodies on inclined plane. Application to problems involving wedges and ladders.	04
04	Kinematics of Particle: Motion of particle with variable acceleration. General curvilinear motion. Tangential & Normal component of acceleration, Motion curves (a-t, v-t, s-t curves). Application of concepts of projectile motion and related numerical.	04
05	Kinematics of Rigid Body: Translation, Rotation and General Plane motion of Rigid body. The concept of Instantaneous center of rotation (ICR) for the velocity. Location of ICR for 2 link mechanism. Velocity analysis of rigid body using ICR.	03
06	6.1 Kinetics of a Particle: Force and Acceleration: -Introduction to basic concepts, D'Alemberts Principle, concept of Inertia force, Equations of dynamic equilibrium, Newton's second law of motion. (Analysis limited to simple systems only.)	04
	6.2 Kinetics of a Particle: Work and Energy: Work Energy principle for a particle in motion. Application of Work – Energy principle to a system consists of connected masses and Springs.	04
	6.3 Kinetics of a Particle: Impulse and Momentum: Principle of linear impulse and momentum. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies.	03

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 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. 10 percentage of marks will be asked from the self-study topics.
3. Total 04 questions need to be solved.
4. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
5. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

6. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. Engineering Mechanics by R. C.Hibbeler.
2. Engineering Mechanics by Beer &Johnston, Tata McGrawHill
3. Engineering Mechanics by F. L. Singer, Harper& RawPublication
4. Engineering Mechanics by Macklin & Nelson, Tata McGrawHill
5. Engineering Mechanics by ShaumSeries
6. Engineering Mechanics by A K Tayal, UmeshPublication.
7. Engineering Mechanics by Kumar, Tata McGrawHill
8. Engineering Mechanics (Statics) by Meriam and Kraige, WileyBools
9. Engineering Mechanics (Dynamics) by Meriam and Kraige, WileyBools

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC105	Basic Electrical Engineering	3	--	--	3	--	--	3	
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.					
FEC105	Basic Electrical Engineering	20	20	20	80	3	--	--	100

Objectives

1. To provide knowledge on fundamentals of D.C. circuits and single phase and three phase AC circuits and its applications.
2. To inculcate knowledge on the basic operation and performance of 1- Φ transformer.
3. To provide knowledge on fundamentals of DC and AC machines.

Outcomes: Learner will be able to...

1. Apply various network theorems to determine the circuit response / behavior.
2. Evaluate and analyze 1- Φ circuits.
3. Evaluate and analyze 3- Φ AC circuits.
4. Understand the constructional features and operation of 1- Φ transformer.
5. Illustrate the working principle of 3- Φ machine.
6. Illustrate the working principle of 1- Φ machines.

Module	Detailed Contents	Hrs.
Prerequisite	Resistance, inductance, capacitance, series and parallel connections of resistance, concepts of voltage, current, power and energy and its units. Working of wattmeter, Magnetic circuits, MMF, Magnetic field strength, reluctance, series and parallel magnetic circuits, BH Curve, Time domain analysis of first order RL and RC circuits	--
01	DC Circuits: (Only independent source) Kirchhoff's Laws, Ideal and practical Voltage and current Sources, Source Transformation, Mesh and Nodal Analysis, Star-Delta / Delta-Star Transformations, Superposition, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.	12
02	AC Circuits :Generation of alternating voltage, basic definitions, average and r.m.s values, phasor and phase difference, sums on phasors, Single-phase ac series and parallel circuits consisting of R, L, C, RL, RC, RLC combinations, definitions - real, reactive and apparent power, admittance (Y), Series and parallel resonance, Q factor	10
03	Generation of Three-Phase Voltages, voltage & current relationships in Star and Delta Connections, power measurement in three phase balanced circuit(Only two wattmeter method).	04

04	Transformers: Working principle of single-phase transformer, EMF equation of a transformer, Transformer losses, Actual (practical) and ideal transformer, Phasor diagram (considering winding resistance and magnetic leakage), Equivalent circuit, Open-circuit test (no-load test), short circuit (SC) test, efficiency.	06
05	Electrical Machines (Numerical not expected): Rotating magnetic field produced by three phase ac, principle of operation of Three-phase induction motor, constructional details and classification of Induction machines.	02
06	Principle of operation of Single-Phase induction motors, stepper motor (Single stack variable reluctance and permanent magnet) (Numerical not expected)	02
Self-study Topic	Principle of operation of DC generators and DC motors, constructional details and classification of DC machines, e.m.f equation of generator/motor, applications. (Theory question can be asked in University exam, no numericals. The percentage of marks allotted should be maximum of 10% (max. 08marks))	--

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 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature. (e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books:

1. V. N. Mittal and Arvind Mittal "Basic Electrical Engineering" Tata McGraw Hill, (Revised Edition)
2. Vincent Del Toro "Electrical Engineering Fundamentals", PHI Second edition, 2011
3. Edward Hughes "Hughes Electrical and Electronic Technology", Pearson Education (Tenth edition)
4. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.
5. M. Naidu, S. Kamakshiah "Introduction to Electrical Engineering" McGraw-Hill Education, 2004
6. B.R Patil "Basic Electrical Engineering" Oxford Higher Education

References:

1. B.L. Theraja "Electrical Engineering" Vol-I and II.
2. S.N. Singh, "Basic Electrical Engineering" PHI, 2011 Book

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL101	Engineering Physics-I	-	01	-	-	-	0.5	0.5	
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.					
FEL101	Engineering Physics-I	--	--	--	--	--	25	--	25

Objectives

1. To improve the knowledge about the theory learned in the class.
2. To improve ability to analyze experimental result and write laboratory report.

Outcomes: Learners will be able to...

1. Perform the experiments based on interference in thin films and analyze the results.
2. Verify the theory learned in the module crystallography.
3. Perform the experiments on various semiconductor devices and analyze their characteristics.
4. Perform simulation study on engineering materials.

Suggested Experiments: (Any five)

1. Determination of radius of curvature of a lens using Newton's ring set up
2. Determination of diameter of wire/hair or thickness of paper using Wedge shape film method.
3. Study of Miller Indices.
4. Study of Hall Effect.
5. Determination of energy band gap of semiconductor.
6. Study of Zener diode as voltage regulator.
7. Study of I/V characteristics of LED
8. Determination of 'h' using Photo cell.
9. Study of I / V characteristics of semiconductor diode
10. Charging and discharging characteristics of supercapacitor.
11. Simulation study of orientational ordering in Nematic like 2D liquid crystal.
12. Simulation experiments based on engineering materials using open source simulation softwares like Avogadro, Chimera, JMOL etc.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) : **10 marks**
- Project Groupwise (Topic Presentation) : **10 marks**
- Attendance (Theory and Tutorial) : **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL102	Engineering Chemistry-I	-	01	-	-	-	0.5	0.5	
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.					
FEL102	Engineering Chemistry-I	--	--	--	--	--	25	--	25

Outcomes: Learners will be able to...

1. Determine Chloride content and hardness of water sample
2. Determine free acid ph of different solutions
3. Determine metal ion concentration
4. Synthesize polymers, biodegradable plastics.
5. Determine Viscosity of oil

Suggested Experiments:

1. To determine Chloride content of water by Mohr's Method.
2. To determine total, temporary and permanent hardness of water sample by EDTA method.
3. To determine free acid pH of different solutions using pH meter
4. To determine metal ion concentration using colorimeter.
5. Removal of hardness using ion exchange column.
6. Molecular weight determination of polymers by Oswald Viscometer.
7. Synthesis of UF, PF, Nylon 66.
8. Determination of COD
9. Synthesis of biodegradable polymer using corn starch or potato starch
10. Determination of Viscosity of oil by Redwood Viscometer

Term work:

Term Work shall consist of minimum five experiments.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) : **10 marks**
- Assignments and Viva on practicals : **10 marks**
- Attendance (Theory and Tutorial) : **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL103	Engineering Mechanics	--	2	--	--	--	1	1	
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.					
FEL103	Engineering Mechanics	--	--	--	--	--	25	25	50

Objectives

1. To acquaint the concept of equilibrium in two and three dimensional system.
2. To study and analyse motion of moving particles/bodies.

Outcomes: Learners will be able to...

1. Verify equations of equilibrium of coplanar force system
2. Verify law of moments.
3. Determine the centroid of plane lamina.
4. Evaluate co-efficient of friction between the different surfaces in contact.
5. Demonstrate the types of collision/impact and determine corresponding coefficient of restitution.
6. Differentiate the kinematics and kinetics of a particle.

List of Experiments:

Minimum six experiments from the following list of which minimum one should from dynamics.

1. Verification of Polygon law of coplanar forces
2. Verification of Principle of Moments (Bell crank lever.)
3. Determination of support reactions of a Simply Supported Beam.
4. Determination of coefficient of friction) using inclined plane
5. Verification of the equations of equilibrium for Non-concurrent non-parallel (General) force system.
6. Collision of elastic bodies (Law of conservation of momentum).
7. Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)
8. Kinetics of particles. (collision of bodies)

Sr No.	Assignments to be completed during Practical Session.	Minimum Number of Numerical
1	Resultant of Coplanar force system	4
2	Resultant of Non-Coplanar force system	3
3	Centroid of Composite plane Laminas	4
4	Equilibrium of System of Coplanar Forces	4
5	Beam Reaction	4
6	Equilibrium of bodies on inclined plane and problems involving wedges and ladders.	4
7	Kinematics of particles (Variable acceleration + Motion Curves +Projectile motion)	4
8	Kinetics of particles (D'Alemberts Principle, Work Energy Principle, Impulse momentum Principle, Impact and Collisions.)	5

Assessment:

Term Work: It comprises Laboratory Experiments and Assignments.

The distribution of marks for term work shall be as follows:

- Practical Work and Journal : 10 marks.
- Assignments : 10 marks.
- Attendance : 05 Marks

End Semester Examination:

Pair of Internal and External Examiner should conduct Oral examination based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL104	Basic Electrical Engineering	--	2	--	--	--	1	1	
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.					
FEL104	Basic Electrical Engineering	--	--	--	--	--	25	25	50

Objectives

1. To impart the basic concept of network analysis and its application.
2. To provide the basic concept of ac circuits analysis and its application.
3. To illustrate the operation of machines and transformer.

Outcomes: Learners will be able to...

1. Interpret and analyse the behaviour of DC circuits using network theorems.
2. Perform and infer experiment on single phase AC circuits.
3. Demonstrate experiment on three phase AC circuits.
4. Illustrate the performance of single phase transformer and machines.

Suggested List of laboratory experiments (Minimum Eight):

Also minimum two experiments from each course outcome shall be covered

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. To measure output voltage across load resistor/current through load resistor and verify the result using Mesh and Nodal analysis.
3. Verification of Superposition Theorem.
4. Verification Thevenin's Theorem.
5. Verification Norton's Theorem.
6. Verification Maximum Power Transfer Theorem.
7. To find the resistance and inductance of a coil connected in series with a pure resistance using three voltmeter method.
8. To find the resistance and inductance of a coil connected in parallel with a pure resistance using three ammeter method.
9. To find resonance conditions in a R-L-C series resonance circuit
10. To find resonance conditions in a R-L-C parallel resonance circuit.
11. To measure relationship between phase and line, currents and voltages in three phase system (star & delta)
12. To measure Power and phase in three phase system by two wattmeter method.
13. To find the equivalent circuit parameters by conducting OC and SC test on single phase transformer
14. To demonstrate cut-out sections of DC machine.
15. To demonstrate cut-out sections of single phase transformer.

Term Work:It comprises both part a and b

Term work consists of performing minimum 06 practical mentioned as below. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/journal) : 10 marks.
- Assignments : 10marks.
- Attendance (Theory and Practical) : 05Marks

End Semester Examination:

Pair of Internal and External Examiner should conduct Oral examination based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL105	Basic Workshop Practice-I	--	2	--	--	--	1	1	
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.					
FEL105	Basic Workshop Practice-I	--	--	--	--	--	50	--	50

Objectives

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Outcomes: Learners will be able to...

1. Develop the necessary skill required to handle/use different fitting tools.
2. Develop skill required for hardware maintenance.
3. Able to install an operating system and system drives.
4. Able to identify the network components and perform basic networking and crimping.
5. Able to prepare the edges of jobs and do simple arc welding.
6. Develop the necessary skill required to handle/use different plumbing tools.
7. Demonstrate the turning operation with the help of a simple job.

	Detailed Content	Hrs.
	<p>Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic at trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to Compulsory Trades.</p>	
Trade-1	<p>Fitting (Compulsory):</p> <ul style="list-style-type: none"> • Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. • Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping 	10

Trade-2	<p>Hardware and Networking: (Compulsory)</p> <ul style="list-style-type: none"> • Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. • Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) • Basic troubleshooting and maintenance • Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students 	08
Trade-3	<p>Welding:</p> <ul style="list-style-type: none"> • Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles. 	06
Trade 4	<p>Plumbing:</p> <ul style="list-style-type: none"> • Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc. 	06
Trade-5	<p>Machine Shop:</p> <ul style="list-style-type: none"> • At least one turning job is to be demonstrated and simple job to be made for Term Work in a group of 4 students. 	06

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC201	Engineering Mathematics-II	3	--	1*	3	1	--	4	
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

Course Objectives

1. The course is aimed to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology.
2. To provide hands on experience in using SCILAB software to handle real life problems.

Course Outcomes: Students will be able to...

1. Apply the concepts of First Order and first degree Differential equation to the problems in the field of engineering.
2. Apply the concepts of Higher Order Linear Differential equation to the engineering problems.
3. Apply concepts of Beta and Gamma function to solve improper integrals.
4. Apply concepts of Double integral of different coordinate systems to the engineering problems like area and mass.
5. Apply concepts of triple integral of different coordinate systems to the engineering problems and problems based on volume of solids.
6. Solve differential equations and integrations numerically using SCILAB software to experimental aspect of applied mathematics.

Module	Detailed Contents	Hrs.
01	Differential Equations of First Order and First Degree 2.1 Exact differential Equations, Equations reducible to exact form by using integrating factors.	4
	1.2 Linear differential equations (Review), equation reducible to linear form, Bernoulli's equation. # Self learning topics: Simple application of differential equation of first order and first degree to electrical and Mechanical Engineering problem	2
02	Linear Differential Equations With Constant Coefficients and Variable Coefficients Of Higher Order 2.1. Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type $f(D)y = X$ where X is e^{ax} , $\sin(ax + b)$, $\cos(ax + b)$, x^n , $e^{ax}V$, xV .	4
	2.2. Method of variation of parameters.	2

	# Self learning topics: Cauchy's homogeneous linear differential equation and Legendre's differential equation, Applications of Higher order differential equation.	
03	Beta and Gamma Function, Differentiation under Integral sign and Rectification Pre-requisite: Tracing of curves 3.1 Beta and Gamma functions and its properties. 3.2 Differentiation under integral sign with constant limits of integration. 3.3 Rectification of plane curves.(Cartesian and polar) # Self learning topics: Rectification of curve in parametric co-ordinates.	2 2 2
04	Multiple Integration-1 4.1. Double integration-definition, Evaluation of Double Integrals.(Cartesian & Polar) 4.2. Evaluation of double integrals by changing the order of integration. 4.3. Evaluation of integrals over the given region.(Cartesian & Polar) # Self learning topics: Application of double integrals to compute Area, Mass.	2 2 2
05	Multiple Integration-2 5.1. Evaluation of double integrals by changing to polar coordinates. 5.2. Application of double integrals to compute Area 5.3. Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). # Self learning topics: Application of triple integral to compute volume.	2 2 2
06	Numerical solution of ordinary differential equations of first order and first degree, and , Numerical Integration 6.1. Numerical solution of ordinary differential equation using (a) Euler's method (b) Modified Euler method, (c) Runge-Kutta fourth order method 6.2. Numerical integration- by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all with proof). # Self learning topics: Numerical solution of ordinary differential equation using Taylor series method.	3 3

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write at least 4 SCILAB tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SCILAB Tutorials will be based on (i) Euler Method, (ii) Modified Euler Method, (iii) Runge-Kutta Method of fourth order , (iv) Trapezoidal Rule , (v) Simpson's 1/3rd Rule (vi) Simpson's 3/8th rule

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.	SCILAB Tutorials	: 10 marks

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 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 9thEd.
3. Engineering Mathematics by Srimanta Pal and SubodhBhunia, Oxford University Press
4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGraw Hill
5. Elementary Linear Algebra with Application by Howard Anton and Christ Rorres. 6th edition.
6. John Wiley & Sons, INC.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC202	Engineering Physics-II	2	--	--	2	--	--	2	
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.					
FEC202	Engineering Physics-II	15	15	15	60	2	--	--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai.

The topic distribution is being done in systematic manner and whenever required, prerequisite to the topic are mentioned for frictionless teaching–learning process. In the distribution of topics, core physics and its applied form are given priority. At the same time few modules are introduced over emerging trends in the field of technology.

For the purpose of emphasis on applied part, list of suggestive experiments is added. As per new guidelines of AICTE, a scope is kept in the syllabus for simulation technique and use of information technology to supplement laboratory practices. Further, it is ensured that these modules will cover prerequisites needed for engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects in respective branches.

Objectives

1. To give exposure to the topics of fundamental physics in the area of electrodynamics and relativity.
2. To give exposure to fundamentals of physics related with current technology in the field of Nanotechnology and Physics of Sensor Technology.

Outcomes: Learners will be able to...

1. Describe the diffraction through slits and its applications.
2. Apply the foundation of laser and fiber optics in development of modern communication technology.
3. Relate the basics of electrodynamics which is prerequisite for satellite communications, antenna theory etc.
4. Explain the fundamentals of relativity.
5. Assimilate the wide scope of nanotechnology in modern developments and its role in emerging innovating applications.
6. Interpret and explore basic sensing techniques for physical measurements in modern instrumentations.

Module	Detailed Contents	Hrs.
01	DIFFRACTION (Prerequisites : Wave front and Huygen's principle, reflection and refraction, diffraction, Fresnel diffraction and Fraunhofer diffraction)	04

	Diffraction: Fraunhofer diffraction at single slit, Diffraction Grating, Resolving power of a grating; Applications of diffraction grating; Determination of wavelength of light using plane transmission grating	
02	<p>LASER AND FIBRE OPTICS (Prerequisites: Absorption, recombination, energy bands of p-n junction, refractive index of a material, Snell's law)</p> <p>Laser: spontaneous emission and stimulated emission; metastable state, population inversion, types of pumping, resonant cavity, Einstein's equations; Helium Neon laser; Nd:YAG laser; Semiconductor laser, Applications of laser- Holography</p> <p>Fibre optics: Numerical Aperture for step index fibre; critical angle; angle of acceptance; V number; number of modes of propagation; types of optical fibres; Fibre optic communication system;</p>	06
03	<p>ELECTRODYNAMICS (Prerequisites : Electric Charges, Coulomb's law-force between two point charges, Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, Gauss's law, Faraday's law)</p> <p>Scalar and Vector field, Physical significance of gradient, curl and divergence in Cartesian co-ordinate system, Gauss's law for electrostatics, Gauss's law for magnetostatics, Faraday's Law and Ampere's circuital law; Maxwell's equations (Free space and time varying fields).</p>	05
04	<p>RELATIVITY (Prerequisites: Cartesian co-ordinate system)</p> <p>Special theory of Relativity: Inertial and Non-inertial Frames of reference, Galilean transformations, Lorentz transformations (space – time coordinates), Time Dilation, Length Contraction and Mass-Energy relation.</p>	02
05	<p>NANOTECHNOLOGY (Prerequisites : Scattering of electrons, Tunneling effect, Electrostatic focusing, magneto static focusing)</p> <p>Nanomaterials : Properties (Optical, electrical, magnetic, structural, mechanical) and applications, Surface to volume ratio; Two main approaches in nanotechnology -Bottom up technique and Top down technique;</p> <p>Tools for characterization of Nanoparticles: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM).</p> <p>Methods to synthesize Nanomaterials: Ball milling, Sputtering, Vapour deposition, Solgel</p>	04
06	<p>PHYSICS OF SENSORS (Prerequisites : Transducer concept, meaning of calibration, piezoelectric effect)</p> <p>Resistive sensors: a) Temperature measurement: PT100 construction, calibration, b) Humidity measurement using resistive sensors,</p> <p>Pressure sensor: Concept of pressure sensing by capacitive, flex and inductive method, Analog pressure sensor: construction working and calibration and applications.</p> <p>Piezoelectric transducers: Concept of piezoelectricity, use of piezoelectric transducer as ultrasonic generator and application of ultrasonic transducer for distance measurement, liquid and air velocity measurement.</p> <p>Optical sensor: Photodiode, construction and use of photodiode as ambient light measurement and flux measurement.</p> <p>Pyroelectric sensors: Construction and working principle, application of pyroelectric sensor as bolometer.</p>	05

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. A text book of Engineering Physics-Avadhanulu&Kshirsagar, S.Chand
2. Optics - Ajay Ghatak, Tata McGraw Hill
3. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
4. Concepts of Modern Physics- ArtherBeiser, Tata Mcgraw Hill
5. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication
6. Introduction to Special Relativity- Robert Resnick, John Wiley and sons
7. Advances In Nano Materials And Applications: History of Nanotechnology From Pre-Historic to Modern Times, Madhuri Sharon, Wiley, USA
8. Nano: The essentials, understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw Hill, 2007.
9. Electronic Instrumentation –H.S. Kalsi, Tata McGraw-Hill Education
10. Handbook of Modern Sensors Physics design and application- Jacob Fraden, Springer, AIP press.
11. Instrumentation & Measurement Techniques by Albert D. Helfrick& William D. Cooper (PHI) Edition

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC203	Engineering Chemistry-II	2	-	-	2	-	-	2	
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.					
FEC203	Engineering Chemistry-II	15	15	15	60	2	--	--	75

Objectives

The concepts developed in this course will aid in quantification as well as understand the applications of several concepts in Chemistry that have been introduced at the 10 + 2 levels in schools.

Outcomes: Learners will be able to...

1. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
2. Illustrate the concept of emission spectroscopy and describe the phenomena of fluorescence and phosphorescence in relation to it.
3. Explain the concept of electrode potential and nernst theory and relate it to electrochemical cells.
4. Identify different types of corrosion and suggest control measures in industries.
5. Illustrate the principles of green chemistry and study environmental impact.
6. Explain the knowledge of determining the quality of fuel and quantify the oxygen required for combustion of fuel.

Module	Detailed Contents	Hrs.
01	Principles of Spectroscopy: Introduction: Principle of spectroscopy, Definition, Origin of spectrum, Classification of spectroscopy – atomic and molecular, selection rules. Table of relation between electromagnetic spectrum, types of spectroscopy and energy changes.	02
02	Applications of Spectroscopy Emission spectroscopy- Principle, Instrumentation and applications (Flame Photometry) Introduction to florescence and phosphorescence, Jablonski diagram, application of fluorescence in medicine only.	04
03	Concept of Electrochemistry Introduction, concept of electrode potential, Nernst equation, types of electrochemical cells, concept of standard electrode with examples, electrochemical series, simplenumericals.	02

04	<p>Corrosion: Definition, Mechanism of Corrosion- (I) Dry or Chemical Corrosion-i) Due to oxygen ii) Due to other gases. (II) Wet or Electrochemical corrosion- Mechanism i) Evolution of hydrogen type ii) Absorption of oxygen. Types of Corrosion- Galvanic cell corrosion, Concentration cell corrosion (differential aeration principle), Pitting corrosion, Intergranular corrosion, Stress corrosion. Factors affecting the rate of corrosion- (i) Nature of metal, (ii) Nature of corroding environment. Methods of corrosion control- (I) Material selection and proper designing, (II) Cathodic protection- i) Sacrificial anodic protection ii) Impressed current method, (III) Metallic coatings- only Cathodic coating (tinning) and anodic coatings (Galvanising)</p>	06
05	<p>Green Chemistry and Synthesis of drugs Introduction – Definition, significance Twelve Principles of Green chemistry, numerical on atom economy, Conventional and green synthesis of Adipic acid, Indigo, Carbaryl, Ibuprofen, Benzimidazole, Benzyl alcohol, % atom economy and their numericals. Green fuel- Biodiesel.</p>	04
06	<p>Fuels and Combustion Definition, classification, characteristics of a good fuel, units of heat (no conversions). Calorific value- Definition, Gross or Higher calorific value & Net or lower calorific value, Dulong's formula & numerical for calculations of Gross and Net calorific values. Solid fuels- Analysis of coal- Proximate and Ultimate Analysis- numerical problems and significance. Liquid fuels- Petrol- Knocking, Octane number, Cetane number, Antiknocking agents, unleaded petrol, oxygenates (MTBE), catalytic converter. Combustion- Calculations for requirement of only oxygen and air (by weight and by volume only) for given solid & gaseous fuels.</p>	06

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

Recommended Books :

1. Engineering Chemistry - Jain & Jain, DhanpatRai
2. Engineering Chemistry – Dara & Dara, S Chand
3. Green Chemistry: A textbook – V.K.Ahluwalia, Alpha Science International
4. Fundamentals of Molecular Spectroscopy (4th Edition) - C.N.Banwell, Elaine M. McCash,
Tata McGraw Hill.
5. Elementary Organic Spectroscopy- Y.R.Sharma, S.Chand and Co.
6. A Text Book of Engineering Chemistry - ShashiChawla, DhanpatRai
7. Engineering Chemistry – Payal Joshi &Shashank Deep (Oxford University Press)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC204	Engineering Graphics	2	--	--	2	--	--	2	
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.					
FEC204	Engineering Graphics	15	15	15	60	3	--	--	75

Objectives

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge of reading a drawing
3. To improve the visualization skill.

Outcomes: Learners will be able to...

1. Apply the basic principles of projections in Projection of Lines and Planes
2. Apply the basic principles of projections in Projection of Solids.
3. Apply the basic principles of sectional views in Section of solids.
4. Apply the basic principles of projections in converting 3D view to 2D drawing.
5. Read a given drawing.
6. Visualize an object from the given two views.

Module	Detailed Contents	Hrs.
01	<p>Introduction to Engineering Graphics Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of Lines, Dimensioning Systems as per IS conventions. Introduction to plain and diagonal scales.</p> <p>Engineering Curves Basic construction of Cycloid, Involute and Helix (of cylinder) only.</p>	2
02	<p>Projection of Points and Lines Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines.</p> <p>@ Projection of Planes Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes).</p>	5
03	<p>Projection of Solids (Prism, Pyramid, Cylinder, Cone only) Solid projection with the axis inclined to HP and VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method</p>	5
04	<p>Section of Solids Section of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to at least one reference plane (Exclude Curved Section Plane). Use change of position or Auxiliary plane method.</p>	5

05	#Orthographic and Sectional Orthographic Projections: - Fundamentals of orthographic projections. Different views of a simple machine part as per the first angle projection method recommended by I.S. Full or Half Sectional views of the Simple Machine parts.	3
06	#@ Missing Views: The identification of missing views from the given views. Create the third view from the two available views so that all the details of the object are obtained.	1
07	#Isometric Views:- Principles of Isometric projection – Isometric Scale, Isometric Views, Conversion of Orthographic Views to Isometric Views(Excluding Sphere).	3
@ only in Term Work (i.e; Questions will not be asked for any examination.)		
# more problems should be discussed during practical hours to strengthen the concepts.		

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each.

Among the two tests One is Conventional (manual drawing) and Second using CAD software.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15marks.
2. Any 4 questions need to be solved. There won't be any compulsory Question
3. Total 04 questions need to be solved.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books.

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

Reference Books

3. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publisher.
4. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies) : Auto CAD 2012 (For engineers and Designers)", Dreamtech Press New Delhi.
5. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC205	C Programming	2	--	--	2	--	--	2	
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.					
FEC205	C Programming	15	15	15	60	2	--	--	75

Objectives

To provide exposure to problem-solving by developing an algorithm, flowchart and implement the logic using C programming language.

Outcomes: Learner will be able to...

1. Formulate simple algorithms for arithmetic, logical problems and translate them to programs in C language
2. Implement, test and execute programs comprising of control structures.
3. Decompose a problem into functions and synthesize a complete program.
4. Demonstrate the use of arrays, strings and structures in C language.
5. Understand the concept of pointers

Module	Detailed Contents	Hrs.
1	Introduction	5
	<ul style="list-style-type: none"> ● Introduction to components of a Computer System ● Introduction to Algorithm and Flowchart 	
1	Fundamentals of C Programming	5
	<ul style="list-style-type: none"> ● Keywords, Identifiers, Constants and Variables ● Data types in C ● Operators in C ● Basic Input and Output Operations ● Expressions and Precedence of Operators ● In-built Functions 	
2	Control Structures	7
	<ul style="list-style-type: none"> ● Introduction to Control Structures 	
2	Branching and looping structures	7
	<ul style="list-style-type: none"> ● If statement, If-else statement, Nested if-else, else-if Ladder ● Switch statement ● For loop, While loop, Do while loop ● break and continue 	
3	Functions	4
	<ul style="list-style-type: none"> ● Introduction to functions ● Function prototype, Function definition, Accessing a function and parameter passing. ● Recursion. 	

4	Arrays and Strings	4
	<ul style="list-style-type: none"> ● Introduction to Arrays ● Declaration and initialization of one dimensional and two-dimensional arrays. ● Definition and initialization of String ● String functions 	
5	Structure and Union	4
	<ul style="list-style-type: none"> ● Concept of Structure and Union ● Declaration and Initialization of structure and union ● Nested structures ● Array of Structures ● Passing structure to functions 	
6	Pointers	4
	<ul style="list-style-type: none"> ● Fundamentals of pointers ● Declaration, initialization and dereferencing of pointers ● Operations on Pointers ● Concept of dynamic memory allocation 	

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books:

1. E. Balaguruswamy, Programming in ANSI C, McGraw-Hill
2. Kernighan , Ritchie, "The C programming Language", Prentice Hall of India
3. Sumitabha Das, Computer Fundamentals and C Programming, McGraw-Hill
4. Pradeep Day and ManasGosh , "Programming in C", Oxford University Press.

References:

1. Byron Gottfried, "Programming with C", McGraw Hill (Schaum's outline series)
2. Venugopal K.R, Prasad Sudeep, "Mastering C", McGraw-Hill
3. Kanetkar Yashwant, "Let Us C", BPB Publication.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEC206	Professional Communication and Ethics- I	2	--	--	2	--	--	2	
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.					
FEC206	Professional Communication and Ethics- I	10	10	10	40	2	--	--	50

Objectives

1. To demonstrate the fundamental concepts of interpersonal and professional communication.
2. To encourage active listening with focus on content, purpose, ideas and tone.
3. To facilitate fluent speaking skills in social, academic and professional situations.
4. To train in reading strategies for comprehending academic and business correspondence.
5. To promote effective writing skills in business, technology and academic arenas.
6. To inculcate confident personality traits along with grooming and social etiquettes.

Outcomes: Learners will be able to understand how to...

1. Eliminate barriers and use verbal/non-verbal cues at social and workplace situations.
2. Employ listening strategies to comprehend wide-ranging vocabulary, grammatical structures, tone and pronunciation.
3. Prepare effectively for speaking at social, academic and business situations.
4. Use reading strategies for faster comprehension, summarization and evaluation of texts.
5. Acquire effective writing skills for drafting academic, business and technical documents.
6. Successfully interact in all kinds of settings, displaying refined grooming and social skills.

Module	Detailed Contents	Hrs.
1	FUNDAMENTALS OF COMMUNICATION	12
	1.1. Introduction to Theory of Communication	
	<ul style="list-style-type: none"> ● Definition ● Objectives ● Postulates/Hallmarks ● The Process of Communication ● Organizational Communication <ul style="list-style-type: none"> ○ Formal (Upward, Downward and Horizontal) ○ Informal (Grapevine) 	
	1.2. Methods of Communication	
	<ul style="list-style-type: none"> ● Verbal (Written & Spoken) ● Non-verbal <ul style="list-style-type: none"> ○ Non-verbal cues perceived through the five senses: (Visual, Auditory, Tactile, Olfactory and Gustatory cues) ○ Non-verbal cues transmitted through the use of: (The Body, Voice, Space, Time and Silence) 	
	1.3. Barriers to Communication	
	<ul style="list-style-type: none"> ● Mechanical/External 	

	<ul style="list-style-type: none"> ● Physical/Internal ● Semantic & Linguistic ● Psychological ● Socio-Cultural <p>1.4. Communication at the Workplace</p> <ul style="list-style-type: none"> ● Corporate Communication - Case Studies ● Listening Tasks with Recordings and Activity Sheets ● Short Speeches as Monologues <ul style="list-style-type: none"> ○ Informative Speeches that Center on People, Events, Processes, Places, or Things ○ Persuasive Speeches to Persuade, Motivate or Take Action ○ Special Occasion Speeches for Ceremonial, Commemorative, or Epideictic purposes ● Pair-work Conversational Activities (Dialogues) ● Short Group Presentations on Business Plans 	
2	<p>VERBAL APTITUDE FOR EMPLOYMENT</p> <p>2.1. Vocabulary Building</p> <ul style="list-style-type: none"> ● Root words (Etymology) ● Meaning of Words in Context ● Synonyms & Antonyms ● Collocations ● Word Form Charts ● Prefixes & Suffixes ● Standard Abbreviations <p>2.2. Grammar</p> <ul style="list-style-type: none"> ● Identifying Common Errors <ul style="list-style-type: none"> ○ Subject - Verb Agreement ○ Misplaced Modifiers ○ Articles ○ Prepositions ● Tautologies ● Pleonasm (Redundancies) ● Idioms ● Cliches 	02
	<p>DEVELOPING READING AND WRITING SKILLS</p> <p>3.1. Reading Comprehension</p> <ul style="list-style-type: none"> ● Long Passages ● Short Passages ● MCQs on Inferential Questions with 4 Options <p>3.2. Summarization of reading passages, reports, chapters, books</p> <ul style="list-style-type: none"> ● Graphic Organizers for Summaries <ul style="list-style-type: none"> ○ Radial Diagrams like Mind Maps ○ Flow Charts ○ Tree Diagrams ○ Cyclic Diagrams ○ Linear Diagrams like Timelines ○ Pyramids ○ Venn Diagrams ● Point-form Summaries ● One-sentence Summaries of Central Idea <p>3.3. Paraphrasing</p> <ul style="list-style-type: none"> ● Understanding Copyrights ● Running a Plagiarism Check on Paraphrased Passages ● Generating Plagiarism Reports 	
3		02

	<ul style="list-style-type: none"> ● Basic APA and MLA Referencing Style and Format 	
4	<p>BUSINESS CORRESPONDENCE</p> <p>4.1. Seven Cs of Business Correspondence</p> <ul style="list-style-type: none"> ● Completeness ● Conciseness ● Consideration ● Concreteness ● Clarity ● Courtesy ● Correctness <p>4.2. Parts of a Formal Letter and Formats</p> <ul style="list-style-type: none"> ● Parts/Elements of a Formal Letter <ul style="list-style-type: none"> ○ Letterheads and/or Sender's Address ○ Dateline ○ Inside Address ○ Reference Line (Optional) ○ Attention Line (Optional) ○ Salutation ○ Subject Line ○ Body ○ Complimentary Close ○ Signature Block ○ Enclosures/Attachments ● Complete/Full Block Format <p>4.3. Emails</p> <ul style="list-style-type: none"> ● Format of Emails ● Features of Effective Emails ● Language and style of Emails <p>4.4. Types of Letters in Both Formal Letter Format and Emails</p> <ul style="list-style-type: none"> ● Claim & Adjustment Letters ● Request/Permission Letters ● Sales Letters 	06
	5	

	<ul style="list-style-type: none"> ● Definition ● Diagram ● Tools/ Apparatus/Software/ Hardware Used ● Working ● Result 	
6	PERSONALITY DEVELOPMENT AND SOCIAL ETIQUETTES	02
	6.1. Personality Development <ul style="list-style-type: none"> ● Introducing Self and/or a Classmate ● Formal Dress Code 6.2. Social Etiquettes <ul style="list-style-type: none"> ● Formal Dining Etiquettes ● Cubicle Etiquettes ● Responsibility in Using Social Media ● Showing Empathy and Respect ● Learning Accountability and Accepting Criticism ● Demonstrating Flexibility and Cooperation ● Selecting Effective Communication Channels 	

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 10 marks each.

TEST I -Public speech on general topics (Maximum 5 mins. per student)

TEST II - Written test covering modules 1 - 6

The second test should be based on theory and application exercises as mentioned in the syllabus. (Note: Summarization should be a compulsory question in Test II and not in the End Semester Theory Examination.)

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. The first module (Fundamentals of Communication) will carry 40 % weightage.

Text Books.

1. Sanjay Kumar & Pushp Lata (2018). Communication Skills with CD. New Delhi: Oxford University Press.
2. Hemphill, P.D., McCormick, D. W., & Hemphill, R. D. (2001). Business Communication with writing improvement exercises. Upper Saddle River, NJ: Prentice Hall.
3. Locker, Kitty O. Kaczmarek, Stephen Kyo. (2019). Business Communication: Building Critical Skills. Place of publication not identified: Mcgraw-hill.
4. Murphy, H. (1999). Effective Business Communication. Place of publication not identified: Mcgraw-Hill.
5. Raman, M., & Sharma, S. (2016). Technical Communication: Principles and practice. New Delhi: Oxford University Press.

6. Kaul, A. (2015). Effective Business Communication. Place of publication not identified: Prentice-Hall of India.
7. Rizvi, A. M. (2010). Effective Technical Communication: A guide for Scientists and Engineers. New Delhi: Tata McGraw Hill.
8. Lewis, N. (2014). Word power made easy. Random House USA.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL201	Engineering Physics-II	-	01	-	-	-	0.5	0.5	
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.					
FEL201	Engineering Physics-II	--	--	--	--	--	25	--	25

Objectives

1. To improve the knowledge about the theory learned in the class.
2. To improve ability to analyze experimental result and write laboratory report.

Outcomes: Learners will be able to...

1. Perform the experiments based on diffraction through slits using Laser source and analyze the results.
2. Perform the experiments using optical fibre to measure numerical aperture of a given fibre.
3. Perform the experiments on various sensors and analyze the result.

Suggested Experiments:(Any five)

1. Determination of wavelength using Diffraction grating. (Hg/Na source)
2. Determination of number of lines on the grating surface using LASER Source.
3. Determination of Numerical Aperture of an optical fibre.
4. Determination of wavelength using Diffraction grating.(Laser source)
5. Study of divergence of laser beam
6. Determination of width of a slit using single slit diffraction experiment(laser source)
7. Study of I-V characteristics of Photo diode.
8. Study of ultrasonic distance meter/ interferometer.
9. Study of PT100 calibration and use and thermometer
10. Study of J /K type thermocouple, calibration and use and thermometer
11. Simulation experiments based on nanotechnology using open source simulation softwares like Avogadro, Chimera, JMOL etc.

Term work:

Term Work shall consist of minimum five experiments.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) : **10 marks**
- Project Groupwise (Execution & Submission) : **10 marks**
- Attendance (Theory and Tutorial) : **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL202	Engineering Chemistry-II	-	01	-	-	-	0.5	0.5	
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.					
FEL202	Engineering Chemistry-II	--	--	--	--	--	25	--	25

Outcomes: Learner will be able to...

1. Determine moisture and ash content of coal
2. Analyze flue gas
3. Determine saponification and acid value of oil
4. Determine flash point of a lubricating oil
5. Synthesize a drug and a biofuel.
6. Determine na/k and emf of cu-zn system

Suggested Experiments

1. Determination of Moisture content of coal.
2. Determination of Ash content of coal.
3. Flue gas analysis using Orsat's apparatus.
4. Saponification value of oil
5. Acid value of oil
6. Determination of Na/K by Flame photometry.
7. Preparation of Biodiesel from edible oil.
8. To estimate the emf of Cu-Zn system by Potentiometry.
9. Synthesis of Aspirin.
10. Determination of Flash point of a lubricant using Abel's apparatus

Term work:

Term Work shall consist of minimum five experiments.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) : **10 marks**
- Assignments and Viva on practicals : **10 marks**
- Attendance (Theory and Practical) : **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL203	Engineering Graphics	-	04	-	-	-	2	2	
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.					
FEL203	Engineering Graphics	--	--	--	--	--	25	50	75

Objectives

1. To inculcate the skill of drawing with the basic concepts.
2. To Use AutoCAD for daily working process.
3. To teach basic utility of Computer Aided drafting (CAD) tool

Outcomes: Learner will be able to...

1. Apply the basic principles of projections in 2D drawings using a CAD software.
2. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.
3. Apply the concepts of layers to create drawing.
4. Apply basic AutoCAD skills to draw different views of a 3D object.
5. Apply basic AutoCAD skills to draw the isometric view from the given two views.

Component-1 (Use half Imperial Drawing Sheet)

	Hrs
Activities to be completed in the Drawing Laboratory.	
One Practice sheet on projection of solids(minimum 2 problems)	4
# Term Sheet 1: Projection of Solids (3 Problems).	4
One Practice sheet on Section of Solids. (minimum 2 problems) # Term Sheet 2: Section of solids. (3 problems).	6
One practice sheet on Orthographic projection. (minimum 1 problem) # Term Sheet 3: Orthographic Projection (With section 1 problem, without section 1 problem).	6
One practice sheet on Isometric drawing. (minimum 2 problems) # Term Sheet 4: Isometric Projection. (3 problems).	4
# Term sheets to be done in laboratory only and to be submitted as part of term work. <i>Note: Practice sheets to be done before starting the Term Sheets.</i>	

Component-2

Self-study problems/ Assignment: (In A3 size Sketch book, to be submitted as part of Term Work)

1. Engineering Curves. (2 problems)
2. Projection of Lines (2 problems)
3. Projection of planes (2 problems)
4. Projection of solids. (2 problems)
5. Section of solids (2 problems)
6. Orthographic Projection. (With section 1 problem, without section 1 problem).
7. Missing views. (1 problem)
8. Isometric Drawing. (2 problems)

Computer Graphics: Engineering Graphics Software - Orthographic Projections, Isometric Projections, Co-ordinate Systems, Multi-view Projection.		
	To be Taught in laboratory.	Hrs
Part-A	Overview of Computer Graphics Covering: Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.	3
	Customization & CAD Drawing: Consisting of set up of the drawing page and the printer including scale settings, Setting up of units and drawing limits, ISO and ANSI standards for coordinate dimensioning.	3
	Annotations, layering & other Functions Covering: Applying dimensions to objects, applying annotations to drawings, Setting up and use of layers, layers to create drawings, Create, edit and use customized layers, Changing line lengths through modifying existing lines (extend/lengthen), Printing documents to paper using the print command, orthographic projection techniques, Drawing sectional views of objects (simple machine parts).	4
Part-B	* Activities to be completed in the CAD Laboratory. (All printouts to be the part of Term Work. Preferably, Use A3 size sheets for print out.) Component-3	
	1. Orthographic Projections (without section)- 1 problem	4
	2. Orthographic Projection (with section)- 1 problem	4
	3. Orthographic Reading – 1 problem	2
	4. Isometric Drawing – 3 problem.	4

Note: * Give practice sheet problems before going for Term Sheet problems.

Students are supposed to bring complete solution of problems before coming to CAD practical.

Term Work:

Component-1	:	7Marks
Component-2	:	6 Marks
Component-3	:	7 Marks
Attendance	:	5 Marks

Total Marks : 25 Marks

Note: Satisfactory submission of all 3 components is mandatory to full fill the Term.

Topic for the End Semester Practical Examination (Auto CAD) (2 hours/ 50 Marks.)

1. Isometric drawing. (1 problem) (20 Marks)
2. Orthographic Projection (With Section) (1 problem). (30 Marks)

Note:

- 1. Printout of the answers have to be taken preferably in A3 size sheets and should be Assessed by External Examiner only.**
- 2. Knowledge of Auto CAD software, concepts of Engineering Graphics related to specified problem and accuracy of drawing should be considered during evaluation.**

Text Books.

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

Reference Books

1. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) &GauravVerma, "(CAD Soft Technologies) : Auto CAD 2012 (For engineers and Designers)", Dreamtech Press NewDelhi.
3. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL204	C programming	--	2	--	--	--	1	1	
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					
FEL204	C programming	--	--	--	--	--	25	25	50

Outcomes: Learner will be able to...

1. Translate given algorithms to a program.
2. Correct syntax and logical errors.
3. Write iterative as well as recursive programs.
4. Represent data in arrays, strings and structures and manipulate them through a program.
5. Declare pointers and demonstrate call by reference concept.

Lab Description:

Weekly 2 hours of laboratory Programming Assignments on the following topics:

1. Basic data types and I/O operations
2. Branching Statements
3. Loop Statements
4. Arrays
5. Strings
6. Functions
7. Recursion
8. Structure and Union
9. Pointers

Term Work:

Experiments (20 Programs) and Assignments (2 Assignments) should be completed by students on the given time duration

Experiments:	15 Marks
Assignment:	05 Marks
Attendance:	05 Marks
Total:	25 Marks

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Practical and Oral :

Practical and oral Exam should be conducted for the Lab, on Computer Programming in C subject for given list of experiments.

Implementation:	15 Marks
Oral:	10 Marks
Total:	25 Marks

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL205	Professional Communication and Ethics- I	--	2	--	--	--	1	1	
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.					
FEL205	Professional Communication and Ethics- I	--	--	--	--	--	25	--	25

Objectives

To provide practice in ...

1. Active listening with focus on content, purpose, main idea, tone and pronunciation.
2. Fluent speaking and presentation skills in social, academic and professional situations.
3. Faster reading skills for effective comprehension in a variety of texts.
4. Drafting effective written discourse in academics, business and technology.
5. Grooming and projecting impressive persona in all interactions.

Outcomes: Learner will be able to...

1. Listen and comprehend all types of spoken discourse successfully.
2. Speak fluently and make effective professional presentations.
3. Read large quantities of text in a short time to comprehend, summarise and evaluate content.
4. Draft precise business letters, academic essays and technical guidelines.
5. Dress finely and conduct themselves with panache in social, academic and professional situations.

List of Assignments & Activities	Details of Assignments	Details of Activities	Hrs.
1.	Written record of listening activities	Listening practice tasks of 3 types (through audio recordings of (1) Monologues (2) Dialogues (3) Formal/Expert Talk or Lecture)	02
2.	Transcription of the public speech along with a plagiarism report	Practice public speech	02
3.	Transcription of the public speech along with a plagiarism report	Public speech (Internal Assessment - I)	02
4.	Written assignment on barriers and non-verbal communication	Role plays / case studies	02
5.	Summarization through graphic organisers (1. Text to graphic	NA	02

	organizer 2. Graphic organizer to text)		
6.	Written record of reading activities	Advanced level reading comprehension with MCQs (similar in level and format to CAT, GRE and GMAT verbal sections)	02
7.	Aptitude test on vocabulary and grammar	Aptitude test on vocabulary and grammar (similar in level and format to CAT, GRE and GMAT verbal sections)	02
8.	2 types of letters in complete block format	NA	02
9.	Written assignment on technical writing (Exercises based on framing Definitions, Describing Technical Objects, Framing User Instructions and Describing Technical Processes)	NA	02
10.	Documentation on case studies / role plays on Module 6	Case studies / role plays	02

Assessment:

The distribution of marks for term work shall be as follows:

- Assignments : **20 marks**
- Attendance (Theory and Practical) : **05 marks**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total	
FEL206	Basic Workshop Practice-II	--	2	--	--	--	1	1	
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.					
FEL206	Basic Workshop Practice-II	--	--	--	--	--	50	--	50

Objectives

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Outcomes: Learner will be able to...

1. Develop the necessary skill required to handle/use different carpentry tools.
2. Identify and understand the safe practices to adopt in electrical environment.
3. Demonstrate the wiring practices for the connection of simple electrical load/ equipment.
4. Design, fabricate and assemble pcb.
5. Develop the necessary skill required to handle/use different masons tools.
6. Develop the necessary skill required to use different sheet metal and brazing tools.
7. Able to demonstrate the operation, forging with the help of a simple job.

	Detailed Content	Hrs.
	<p>Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work</p> <p>CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to Compulsory Trades.</p>	
Trade-1	<p>Carpentry(Compulsory)</p> <p>6. Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods.</p> <p>7. Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning</p>	10

Trade-2	<p>Basic Electrical work shop:(Compulsory):</p> <p>8. Single phase and three phase wiring. Familiarization. of protection switchgears and their ratings (fuse, MCB, ELCB). Wiring standards, Electrical safety in the work place safe work practices. Protective equipment, measures and tools.</p> <p>9. Layout drawing, layout transfer to PCB, etching and drilling and soldering technique</p>	08
Trade-3	<p>Masonry:</p> <p>10. Use of masons tools like trowels, hammer, spirit level, square, plumb line and pins etc. demonstration of mortar making, single and one and half brick masonry , English and Flemish bonds, block masonry, pointing and plastering.</p>	06
Trade 4	<p>Sheet metal working and Brazing:</p> <p>11. Use of sheet metal, working hand tools, cutting , bending , spot welding</p>	06
Trade-5	<p>Forging (Smithy):</p> <p>12. At least one forging job to be demonstrated and a simple job to be made for Term Work in a group of 4 students.</p>	06

UNIVERSITY OF MUMBAI



Bachelor of Engineering

First Year Engineering (Semester I & II), Revised course

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

(Common for All Branches of Engineering)

Under

FACULTY OF SCIENCE & TECHNOLOGY

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

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	
Total		13	08	01	13	04	01	18	
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
Total		--	--	90	360	--	175	50	675

* Shall 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	
Total		13	12	01	13	06	01	20	
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
Total		--	--	90	360	--	200	75	725

* Shall be conducted batch-wise

University of Mumbai



No. UG/ 50 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to the syllabus directly uploaded by the Academic Authority Unit which was accepted by the Academic Council at its meeting held on 11th May, 2017 **vide** item No.4.193 relating to the revised syllabus as per the (CBCGS) for Bachelor of Engineering (Computer Engineering) Second Year w.e.f. AY 2017-18, Third Year w.e.f. AY 2018-19 and Final Year w.e.f. AY 2019-20 (Rev – 2016) from Academic Year 2016-17.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Computer Engineering at its meeting held on 7th May, 2020 and subsequently made by the Board of Deans at its meeting held on 26th June, 2020 vide item No. 14(11) have been accepted by the Academic Council at its meeting held on 23rd July, 2020 **vide** item No. 4.127 and that in accordance therewith, the revised syllabus (Rev-2019 'C' Scheme) for the B.E. in Computer Engineering (Sem.III & IV) has been brought into force with effect from the academic year 2020-21. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

21st January, 2021

To

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

A.C/4.127/23/07/2020

No. UG/ 50 -A of 2021

MUMBAI-400 032

21st January, 2021

Copy forwarded with Compliments for information to:-

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

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

Copy to :-

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

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

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

for information.

AC: 23/7/2020
Item No. 4327

UNIVERSITY OF MUMBAI



Syllabus for Approval

Date

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

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

Dr. Anuradha Majumdar
Dr Anuradha Majumdar
Dean
Faculty of Science and Technology
University of Mumbai

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	Second Year B.E. Computer Engineering
2	Eligibility for Admission	After Passing First Year Engineering as per the Ordinance 0.6242
3	Passing Marks	40%
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7	Pattern	Yearly / Semester (Strike out which is not applicable)
8	Status	New / Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	With effect from Academic Year: 2020-2021

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 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg					
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
Total		--	--	100	400	--	175	100	775

*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 [§]	--	--	2	--	2	
Total		15	16	1	15	7	1	24	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
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
Total		--	--	100	400	--	175	100	775

*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	Laplace Transform	7
	1.1 Definition of Laplace transform, Condition of Existence of Laplace transform.	
	1.2 Laplace Transform (L) of standard functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , $n \geq 0$.	
	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 Self-learning Topics: Laplace Transform: Periodic functions, Heaviside's Unit Step function, Dirac Delta Function, Special functions (Error and Bessel)	
2	Inverse Laplace Transform	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 Self-learning Topics: Applications to solve initial and boundary value	

		problems involving ordinary differential equations.	
3	Fourier Series:		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 2π and $2l$.	
	3.3	Fourier series of even and odd functions.	
	3.4	Half range Sine and Cosine Series.	
	3.5	Self-learning Topics: Orthogonal and orthonormal set of functions, Complex form of Fourier Series, Fourier Transforms.	
4	Complex Variables:		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	Self-learning Topics: Conformal mapping, Linear and Bilinear mappings, cross ratio, fixed points and standard transformations.	
5	Statistical Techniques		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	Self-learning Topics: Covariance, fitting of exponential curve.	
6	Probability		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 th order.	
	6.5	Self-learning Topics: 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 nd 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	Logic	6
	1.1 Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.	
2	Relations and Functions	6
	2.1 Basic concepts of Set Theory	
	2.2 Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes	
	2.3 Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function	
3	Posets and Lattice	5
	3.1 Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice	
4	Counting	6
	4.1 Basic Counting Principle-Sum Rule, Product Rule, Inclusion-Exclusion Principle, Pigeonhole Principle	
	4.2 Recurrence relations, Solving recurrence relations	
5	Algebraic Structures	8
	5.1 Algebraic structures with one binary operation: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism	
	5.2 Algebraic structures with two binary operations: Ring	
	5.3 Coding Theory: Coding, binary information and error detection, decoding and error correction	
6	Graph Theory	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.	
--	---------------	--

Textbooks:	
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
References:	
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.

Assessment:	
Internal Assessment Test:	
The assessment consists of two class tests of 20 marks each. The 1 st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2 nd 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.	
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.

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

Course Code	Course Name	Credit
CSC303	Data Structure	03

Pre-requisite: C Programming	
Course Objectives: 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.
Course Outcomes:	
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	Introduction to Data Structures	2
	1.1 Introduction to Data Structures, Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures.	
2	Stack and Queues	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	Linked List	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	Trees	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	Graphs	4

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

Textbooks:

1	Aaron M Tenenbaum, Yedidyah 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 nd 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 nd 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	https://nptel.ac.in/courses/106/102/106102064/
2	https://www.coursera.org/specializations/data-structures-algorithms
3	https://www.edx.org/course/data-structures-fundamentals
4	https://swayam.gov.in/nd1_noc19_cs67/preview

Course Code	Course Name	Credit
CSC304	Digital Logic & Computer Organization and Architecture	3

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.

Module	Detailed Content	Hours
1	Computer Fundamentals	5
	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.	
2	Data Representation and Arithmetic algorithms	8
	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.	
3	Processor Organization and Architecture	6
	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.	
4	Control Unit Design	6
	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.	
5	Memory Organization	6
	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.	
6		Principles of Advanced Processor and Buses	8
	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 th Edition.
2	William Stallings, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10 TH Edition.
3	John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3 RD 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 rd 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	https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824
2	https://nptel.ac.in/courses/106/103/106103068/
3	https://www.coursera.org/learn/comparch
4	https://www.edx.org/learn/computer-architecture

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
1		Introduction and Overview of Graphics System:	02
	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.	
2		Output Primitives:	10
	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.	
3		Two Dimensional Geometric Transformations	6
	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	
4		Two-Dimensional Viewing and Clipping	7
	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.	
5		Three Dimensional Geometric Transformations, Curves and Fractal Generation	8
	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.	
6		Visible Surface Detection and Animation	6
	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	

Textbooks:

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 nd Edition, Pearson Publication
3	Samit Bhattacharya, “Computer Graphics”, Oxford Publication

References:

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.

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	https://www.classcentral.com/course/interactivegraphics-2067
2	https://swayam.gov.in/nd2_ntr20_ed15/preview
3	https://nptel.ac.in/courses/106/106/106106090/
4	https://www.edx.org/course/computer-graphics-2

Lab Code	Lab Name	Credit
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	www.leetcode.com
2	www.hackerrank.com
3	www.cs.usfca.edu/~galles/visualization/Algorithms.html
4	www.codechef.com

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

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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Course Code	Lab Name	Credits
CSL303	Computer Graphics Lab	1

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:

Sr. No.	Name of the Experiment
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

Lab Code	Lab Name	Credits
CSL304	Skill based Lab Course: Object Oriented Programming with Java	2

Prerequisite: Structured Programming Approach

Lab Objectives:

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.

Lab Outcomes: 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
1		Introduction to Object Oriented Programming	2
	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.	
2		Class, Object, Packages and Input/output	6
	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	
3		Array, String and Vector	3
	3.1	Array, Strings, String Buffer, Vectors	
4		Inheritance	4
	4.1	Types of inheritance, Method overriding, super, abstract class and abstract method, final, Multiple inheritance using interface, extends keyword	
5		Exception handling and Multithreading	5
	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.	
6		GUI programming in JAVA	6
	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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Textbooks:	
1	Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2	E. Balagurusamy, 'Programming with Java', McGraw Hill Education.
References:	
1	Ivor Horton, "Beginning JAVA", Wiley India.
2	Dietal and Dietal, "Java: How to Program", 8 th Edition, PHI .
3	"JAVA Programming", Black Book, Dreamtech Press.
4	"Learn to Master Java programming", Staredu solutions
Digital material:	
1	www.nptelvideos.in
2	www.w3schools.com
3	www.tutorialspoint.com
4	https://starcertification.org/Certifications/Certificate/securejava

Suggested List of Programming Assignments/laboratory Work:	
Sr. No.	Name of the Experiment
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)

Term Work:	
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)

Oral & Practical exam	
Based on the entire syllabus of CSL 304: Skill based Lab Course: Object Oriented Programming with Java	

Course code	Course Name	Credits
CSM301	Mini Project A	02

Objectives	
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.
Outcome: 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.
Guidelines for Mini Project	
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.

Term Work	
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.	
Distribution of Term work marks for both semesters shall be as below:	
Marks	
1	Marks awarded by guide/supervisor based on logbook
2	Marks awarded by review committee
3	Quality of Project report
10	
10	
05	
Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines	
One-year project:	
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"> • First shall be for finalization of problem • Second shall be on finalization of proposed solution of problem.
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"> • First review is based on readiness of building working prototype to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.
Half-year project:	
1	In this case in one semester students' group shall complete project in all aspects including, <ul style="list-style-type: none"> • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, <ul style="list-style-type: none"> • First shall be for finalization of problem and proposed solution • Second shall be for implementation and testing of solution.
Assessment criteria of Mini Project.	
Mini Project 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 one year, project , 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 half year project all criteria's in generic may be considered for evaluation of performance of students in mini project.
Guidelines for Assessment of Mini Project Practical/Oral Examination:	
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.
Mini Project 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	Linear Algebra (Theory of Matrices)	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 Self-learning Topics: Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.	
2	Complex Integration	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 Self-learning Topics: Application of Residue Theorem to evaluate real integrations.	
3	Z Transform	5
	3.1 Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}, \{a^{ k }\}, \{k^n C. a^k\}, \{c^k \sin(\alpha k + \beta)\}, \{c^k \sinh ak\}, \{c^k \cosh ak\}$.	
	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 Self-learning Topics: Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion	
4	Probability Distribution and Sampling Theory	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	Self-learning Topics: Test significance for Large samples, Estimate parameters of a population, Yate's Correction.	
5	Linear Programming Problems		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	Self-learning Topics: Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	
6	Nonlinear Programming Problems		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	Self-learning Topics: 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 2nd 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		Introduction	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		Divide and Conquer Approach	6
	2.1	General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search.	
3		Greedy Method Approach	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		Dynamic Programming Approach	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		Backtracking and Branch and bound	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		String Matching Algorithms	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 nd 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	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
3	https://www.coursera.org/specializations/algorithms
4	https://www.mooc-list.com/tags/algorithms

Course Code:	Course Title	Credit
CSC403	Database Management System	3

Prerequisite: Data Structures	
Course Objectives:	
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.
Course Outcomes:	
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.

Module	Content	Hrs
1	Introduction Database Concepts	3
	1.1 Introduction, Characteristics of databases, File system v/s Database system, Data abstraction and data Independence, DBMS system architecture, Database Administrator	
2	Entity–Relationship Data Model	6
	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	
3	Relational Model and relational Algebra	8
	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.	
4	Structured Query Language (SQL)	6
	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	
5	Relational-Database Design	6
	5.1 Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF.	
6	Transactions Management and Concurrency and Recovery	10
	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	

Textbooks:	
1	Korth, Silberchatz, Sudarshan, Database System Concepts, 6 th Edition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5 th Edition, Pearson Education
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
References:	
1	Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5 th 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

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	https://nptel.ac.in/courses/106/105/106105175/
2	https://swayam.gov.in/nd1_noc19_cs46/preview
3	https://www.classcentral.com/course/swayam-database-management-system-9914
4	https://www.mooc-list.com/tags/dbms

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
1	Operating system Overview	4
	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	
2	Process and Process Scheduling	9
	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	
3	Process Synchronization and Deadlocks	9
	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.	
4	Memory Management	9
	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	
5	File Management	4

	5.1	Overview, File Organization and Access, File Directories, File Sharing	
6		I/O management	4
	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 th 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 th Edition, 2016, ISBN 978-81-265-5427-0

References:

1	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3 rd Edition
2	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3 rd Edition.
3	Maurice J. Bach, “Design of UNIX Operating System”, PHI
4	Sumitabha Das, “UNIX: Concepts and Applications”, McGraw Hill, 4 th 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	https://swayam.gov.in/nd1_noc19_cs50/preview
2	https://nptel.ac.in/courses/117/106/117106113/
3	https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559

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
1	The Intel Microprocessors 8086 Architecture	8
	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	
2	Instruction Set and Programming	6
	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	
3	Memory and Peripherals interfacing	8
	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.	
4	Intel 80386DX Processor	7
	4.1 Architecture of 80386 microprocessor	
	4.2 80386 registers–General purpose Registers, EFLAGS and Control	

		registers	
	4.3	Real mode, Protected mode, virtual 8086 mode	
	4.4	80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism	
5	Pentium Processor		6
	5.1	Pentium Architecture	
	5.2	Superscalar Operation,	
	5.3	Integer & Floating-Point Pipeline Stages,	
	5.4	Branch Prediction Logic,	
	5.5	Cache Organization and	
	5.6	MESI protocol	
6	Pentium 4		4
	6.1	Comparative study of 8086, 80386, Pentium I, Pentium II and Pentium III	
	6.2	Pentium 4: Net burst micro architecture.	
	6.3	Instruction translation look aside buffer and branch prediction	
	6.4	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 th 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 th 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	https://swayam.gov.in/nd1_noc20_ee11/preview
2	https://nptel.ac.in/courses/108/105/108105102/
3	https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4	https://www.mooc-list.com/tags/microprocessors

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
1		Introduction
	1.1	Selection sort, Insertion sort
2		Divide and Conquer Approach
	2.1	Finding Minimum and Maximum, Merge sort, Quick sort, Binary search
3		Greedy Method Approach
	3.1	Single source shortest path- Dijkstra Fractional Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm
4		Dynamic Programming Approach
	4.1	Single source shortest path- Bellman Ford All pair shortest path- Floyd Warshall 0/1 knapsack Travelling salesperson problem Longest common subsequence
5		Backtracking and Branch and bound
	5.1	N-queen problem Sum of subsets Graph coloring
6		String Matching Algorithms
	6.1	The Naïve string-matching Algorithms The Rabin Karp algorithm The Knuth-Morris-Pratt algorithm

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 “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)
Oral & Practical exam	
	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

Course Code	Course Name	Credit
CSL403	Operating System Lab	01
Based on the entire syllabus of CSC403: Database Management System		

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
1	Explore Linux Commands
	1.1 Explore usage of basic Linux Commands and system calls for file, directory and process management. 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.)
2	Linux shell script
	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.
3	Linux- API
3.1	Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs.
4	Linux- Process
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.
5	Process Management: Scheduling

	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
6		Process Management: Synchronization
	6.1	a. Write a C program to implement solution of Producer consumer problem through Semaphore
7		Process Management: Deadlock
	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 Philospher's Problem
8		Memory Management
	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.
9		Memory Management: Virtual Memory
	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.
10		File Management & I/O Management
	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

Term Work:	
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)
Oral & Practical exam	
	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)

Oral & Practical exam

Based on the entire syllabus of CSL501and CSC501syllabus.

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
1		Python basics	5
	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	
2		Advanced Python	4
	2.1	Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.	
3		Data Structure in Python	3
	3.1	Link List, Stack, Queues, Dequeues	
4		Python Integration Primer	4
	4.1	Graphical User interface, Networking in Python, Python database connectivity, Introduction to Django	
5		Multithreading	4
	5.1	Thread and Process, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue	
6		NumPy and Pandas	6
	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 rd Edition, Zed Shaw's Hard Way Series
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2	Laura Cassell, Alan Gauld, “Python Projects”, Wrox Publication
Digital material:	
1	"The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
2	Beginning Perl, https://www.perl.org/books/beginning-perl/
3	http://spoken-tutorial.org
4	https://starcertification.org/Certifications/Certificate/python

Suggested experiments using Python:	
Sr. No.	Title of Experiments
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 (create, read, update and delete) 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.

Term Work:	
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

Objectives	
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.
Outcome: 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.
Guidelines for Mini Project	
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.

Term Work	
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.	
Distribution of Term work marks for both semesters shall be as below:	
	Marks
1	Marks awarded by guide/supervisor based on logbook
2	Marks awarded by review committee
3	Quality of Project report
Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines	
One-year project:	
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"> • First shall be for finalization of problem • Second shall be on finalization of proposed solution of problem.
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"> • First review is based on readiness of building working prototype to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.
Half-year project:	
1	In this case in one semester students' group shall complete project in all aspects including, <ul style="list-style-type: none"> • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, <ul style="list-style-type: none"> • First shall be for finalization of problem and proposed solution • Second shall be for implementation and testing of solution.
Assessment criteria of Mini Project.	
Mini Project 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 one year, project , 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 half year project all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

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.

Mini Project 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



No. UG/ 52 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to the syllabus directly uploaded by the Academic Authority Unit which was accepted by the Academic Council at its meeting held on 11th May, 2017 vide item No.4.189 relating to the revised syllabus as per the (CBCGS) for Bachelor of Engineering (Chemical Engineering) Second Year w.e.f. AY 2017-18, Third Year w.e.f. AY 2018-19 and Final Year w.e.f. AY 2019-20 (Rev – 2016) from Academic Year 2016-17.

They are hereby informed that the recommendations made by the Board of Studies in Chemical Engineering at its meeting held on 29th June, 2020 and subsequently made by the Board of Deans at its meeting held on 20th July, 2020 vide item No. 9 have been accepted by the Academic Council at its meeting held on 23rd July, 2020 vide item No. 4.136 and that in accordance therewith, the revised scheme (Rev-2019 'C' Scheme) for the B.E. in Chemical Engineering (Sem.III to VIII) has been brought into force with effect from the academic year 2020-21. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

21st January, 2021

To

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

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

A.C/4.136/23/07/2020

No. UG/ 52 -A of 2021

MUMBAI-400 032

21st January, 2021

Copy forwarded with Compliments for information to:-

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

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

Copy to :-

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

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

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

for information.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Chemical 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 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

Preamble to the Revision of Syllabus in Chemical Engineering

Development in all fields including Chemical Engineering along with use of soft wares for process plant and process engineering, there is demand on academicians to upgrade the curriculum in 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. The Curriculum must integrate knowledge of the basic and advanced sciences with problem solving and creativity abilities.

The Curriculum must be broad enough to cover all areas from design to operation of Process plants. It should be deep enough to enable the learners to carry out research and develop products to meet rapidly changing needs and demands. The major challenge in the current scenario is to ensure quality to the stakeholders. 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.

With these objectives, online meeting was organized on 30th May 2020 which was attended by heads of the departments and subject faculty of affiliating Institutes. The program objectives and outcomes were thoroughly discussed in line with AICTE guidelines and the core structure of the syllabus was formulated keeping in mind choice based credit and grading system curriculum along with more emphasis on learning outcomes. Thus Skilled based laboratories and Mini projects are introduced in appropriate semesters. Views from experts and UG teachers were taken into consideration and final Academic and Exam scheme was prepared with the consent of all the members involved. Subject wise online meetings were held by various subjects convenors to finalize the detail syllabus in the month of June 2020.

The Program Educational Objectives finalized for the undergraduate program in Chemical Engineering are:

1. To prepare the student for mathematical, scientific and engineering fundamentals
2. To motivate the student to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social and environmental responsibilities.
4. To prepare the student in achieving excellence which will benefit individually and society at large.

Board of Studies in Chemical Engineering

Dr. Sunil S. Bhagwat - Chairman

Dr. Kalpana S. Deshmukh - Member

Dr. Sunil J. Kulkarni - Member

Dr. Ramesh S. Bhande - Member

Dr. Aparna N. Tamaskar - Member

Dr. Shyamala P. Shingare - Member

Dr. Manisha V. Bagal - Member

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2020-2021)

Semester III

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			Total
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	
CHC301	Engineering Mathematics-III	3	-	1	3	-	1	4
CHC302	Industrial and Engineering Chemistry I	3	-	-	3	-	-	3
CHC303	Fluid Flow Operations	3	-	-	3	-	-	3
CHC304	Chemical Engineering Thermodynamics I	3	-	-	3	-	-	3
CHC305	Process Calculations	3	-	-	3	-	-	3
CHL301	Industrial and Engineering Chemistry I Lab	-	3	-	-	1.5	-	1.5
CHL302	Fluid Flow Operation Lab	-	3	-	-	1.5	-	1.5
CHL303	Basic Chemical Engineering Lab	-	3	-	-	1.5	-	1.5
CHL304	Skilled Based Lab: Chemical Technology Lab	-	2*2	-	-	2	-	2
CHM301	Mini Project 1A	-	3#	-	-	1.5	-	1.5
	Total	15	16	1	15	8	1	24

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract /Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC301	Engineering Mathematics-III	20	20	20	80	3	25	-	-	125
CHC302	Industrial and Engineering Chemistry I	20	20	20	80	3	-	-	-	100
CHC303	Fluid Flow Operations	20	20	20	80	3	-	-	-	100
CHC304	Chemical Engineering Thermodynamics I	20	20	20	80	3	-	-	-	100
CHC305	Process Calculations	20	20	20	80	3	-	-	-	100
CHL301	Industrial and Engineering Chemistry I Lab	-	-	-	-	3	25	25	-	50
CHL302	Fluid Flow Operation Lab	-	-	-	-	3	25	25	-	50
CHL303	Basic Chemical Engineering Lab	-	-	-	-	-	25	-	25	50
CHL304	Skilled Based Lab: Chemical Technology Lab	-	-	-	-	-	25	-	25	50
CHM301	Mini Project 1A	-	-	-	-	-	25	-	25	50
	Total	-	-	100	400	-	150	50	75	775

*Indicates Theory class to be conducted for full class;

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

For mini project faculty load: 1 hour per week per four groups

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2020-2021)
Semester IV

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			Total
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	
CHC401	Engineering Mathematics-IV	3	-	1	3	-	1	4
CHC402	Industrial and Engineering Chemistry II	3	-		3	-	-	3
CHC403	Numerical Method in Chemical Engineering	3	-	-	3	-	-	3
CHC404	Solid Fluid Mechanical Operations	3	-	-	3	-	-	3
CHC405	Chemical Engineering Thermodynamics II	3	-	-	3	-	-	3
CHL401	Industrial and Engineering Chemistry II Lab	-	3	-	-	1.5	-	1.5
CHL402	Numerical Method in Chemical Engineering Lab	-	3	-	-	1.5	-	1.5
CHL403	Solid Fluid Mechanical Operation Lab	-	3	-	-	1.5	-	1.5
CHL404	Skilled based lab: Design Calculation of Auxiliary Plant Equipment	-	3	-	-	1.5	-	1.5
CHM401	Mini Project 1B	-	2#	--	-	1		1
	Total	15	14	1	15	7	1	23

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract /Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC401	Engineering Mathematics-IV	20	20	20	80	3	25	-	-	125
CHC402	Industrial and Engineering Chemistry II	20	20	20	80	3	-	-	-	100
CHC403	Numerical Method in Chemical Engineering	20	20	20	80	3	-	-	-	100
CHC404	Solid Fluid Mechanical Operations	20	20	20	80	3	-	-	-	100
CHC405	Chemical Engineering Thermodynamics II	20	20	20	80	3	-	-	-	100
CHL401	Industrial and Engineering Chemistry II Lab	-	-	-	-	3	25	25	-	50
CHL402	Numerical Method in Chemical Engineering Lab	-	-	-	-	-	25	-	25	50
CHL403	Solid Fluid Mechanical Operation Lab	-	-	-	-	3	25	25	-	50
CHL404	Skilled based lab: Design Calculation of Auxiliary Plant Equipment	-	-	-	-	-	25	-	25	50
CHM401	Mini Project 1B	-	-	-	-	-	25	-	25	50
	Total	-	-	100	400	-	150	50	75	775

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

For mini project faculty load : 1 hour per week per four groups

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2021-2022)
Semester V

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CHC501	Mass transfer Operations-I	3	-	-	3	-	-	3
CHC502	Heat transfer Operations	3	-	-	3	-	-	3
CHC503	Chemical Reaction Engineering-I	3	-	-	3	-	-	3
CHC504	Transport Phenomena	3	-	-	3	-	-	3
CHDO501X	Department Optional Course 1	3	-	-	3	-	-	3
CHL501	Mass transfer Operations-I Lab	-	3	-	-	1.5	-	1.5
CHL502	Heat transfer Operations Lab	-	3	-	-	1.5	-	1.5
CHL503	Chemical Reaction Engineering-I Lab	-	3	-	-	1.5	-	1.5
CHL504	Skilled Based Lab: Business Communication and Ethics Lab	-	2*2	-	-	2	-	2
CHM501	Mini Project-2A	-	3#	-	-	1.5	-	1.5
	Total	15	14	-	15	8	-	23

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract /Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC501	Mass transfer Operations-I	20	20	20	80	3	-	-	-	100
CHC502	Heat transfer Operations	20	20	20	80	3	-	-	-	100
CHC503	Chemical Reaction Engineering-I	20	20	20	80	3	-	-	-	100
CHC504	Transport Phenomena	20	20	20	80	3	-	-	-	100
CHDO501X	Department Optional Course 1	20	20	20	80	3	-	-	-	100
CHL501	Mass transfer Operations-I Lab	-	-	-	-	3	25	25	-	50
CHL502	Heat transfer Operations Lab	-	-	-	-	3	25	25	-	50
CHL503	Chemical Reaction Engineering-I Lab	-	-	-	-	3	25	25	-	50
CHL504	Skilled Based Lab: Business Communication and Ethics Lab	-	-	-	-	-	25	-	25	50
CHM501	Mini Project-2A	-	-	-	-	-	25	-	25	50
	Total			100	400	-	125	75	50	750

Department Optional Course 1 (Semester V)

Engineering Stream (Elective Code)	Technology Stream (Elective Code)	Management Stream
Food Engineering(CHDO5011)	Advanced Material Sciences (CHDO5012)	Total Quality Management (CHDO5013)

*Indicates Theory class to be conducted for full class;

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

For mini project faculty load: 1 hour per week per four groups

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2021-2022)
Semester VI

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CHC601	Mass Transfer Operation II	3	-	-	3	-	-	3
CHC602	Chemical Reaction Engineering II	3	-	-	3	-	-	3
CHC603	Pollution Control Technology	3	-	-	3	-	-	3
CHC604	Process Engineering and Economics	3	-	1	3	-	1	4
CHDO602X	Departmental Optional Course 2	3	-	-	3	-	-	3
CHL601	Mass Transfer Operation II Lab	-	3	-	-	1.5	-	1.5
CHL602	Chemical Reaction Engineering II Lab	-	3	-	-	1.5	-	1.5
CHL603	Pollution Control Technology Lab	-	3	-	-	1.5	-	1.5
CHL604	Skilled Based Lab: Piping Design Engineering Lab	-	3	-	-	1.5	-	1.5
CHM601	Mini Project – 2B	-	2#	-	-	1	-	1
	Total	15	14	1	15	7	1	23

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract /Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC601	Mass Transfer Operation II	20	20	20	80	3	-	-	-	100
CHC602	Chemical Reaction Engineering II	20	20	20	80	3	-	-	-	100
CHC603	Pollution Control Technology	20	20	20	80	3	-	-	-	100
CHC604	Process Engineering and Economics	20	20	20	80	3	25	-	-	125
CHDO602X	Departmental Optional Course 2	20	20	20	80	3	-	-	-	100
CHL601	Mass Transfer Operation II Lab	-	-	-	-	3	25	25	-	50
CHL602	Chemical Reaction Engineering II Lab	-	-	-	-	3	25	25	-	50
CHL603	Pollution Control Technology Lab	-	-	-	-	3	25	25	-	50
CHL604	Skilled Based Lab: Piping Design Engineering Lab	-	-	-	-	-	25	-	25	50
CHM601	Mini Project – 2B	-	-	-	-	-	25	-	25	50
	Total			100	400	-	150	75	50	775

Department Optional Course 2 (Semester VI)

Engineering Stream (Elective Code)	Technology Stream (Elective Code)	Management Stream (Elective Code)
Piping Engineering (CHDO6021)	Polymer Technology (CHDO6022)	Industrial Organization and Management (CHDO6023)

indicates work load of Learner (Not Faculty), for Mini Project; For mini project faculty load : 1 hour per week per four groups

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2022-2023)
Semester VII

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CHC701	Instrumentation Process Dynamics and Control	3	-	-	3	-	-	3
CHC702	Chemical Engineering Equipment Design	3	-	-	3	-	-	3
CHDO703X	Department Optional Course 3	3	-	-	3	-	-	3
CHDO704X	Department Optional Course 4	3	-	-	3	-	-	3
IOC701X	Institute Optional Course 1	3	-	-	3	-	-	3
CHL701	Instrumentation Process Dynamics and Control Lab	-	3	-	-	1,5	-	1,5
CHL702	Chemical Engineering Equipment Design Lab	-	3	-	-	1,5	-	1,5
CHL703	Hazard and Risk Analysis Lab	-	2	-	-	1	-	1
CHP701	Major Project I	-	6#	-	-	3	-	3
	Total	15	8	-	15	7	-	22

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract /Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC701	Instrumentation Process Dynamics and Control	20	20	20	80	3	-	-	-	100
CHC702	Chemical Engineering Equipment Design	20	20	20	80	3	-	-	-	100
CHDO703X	Department Optional Course 3	20	20	20	80	3	-	-	-	100
CHDO704X	Department Optional Course 4	20	20	20	80	3	-	-	-	100
IOC701X	Institute Optional Course 1	20	20	20	80	3	-	-	-	100
CHL701	Instrumentation Process Dynamics and Control Lab	-	-	-	-	3	25	25	-	50
CHL702	Chemical Engineering Equipment Design Lab	-	-	-	-	-	25	-	25	50
CHL703	Hazard and Risk Analysis Lab	-	-	-	-	-	25	-	25	50
CHP701	Major Project I	-	-	-	-	3	25	-	25	50
	Total	-	-	100	400	-	100	25	75	700

Department Optional Course 3 (Semester VII)

Engineering Stream (Elective Code)	Technology Stream (Elective Code)	Management Stream (Elective)
Corrosion Engineering (CHDO7031)	Fundamental of Colloids and Interface Science and Technology (CHDO7032)	Project Management for Chemical Process Industries (CHDO7033)

Department Optional Course 4 (Semester VII)

Engineering Stream (Elective Code)	Technology Stream (Elective Code)	Management Stream (Elective)
Chemical Plant Safety and Hazards (CHDO7041)	Petroleum Refining Technology (CHDO7042)	Operation Research (CHDO7043)

indicates work load of Learner (Not Faculty), for Major Project; faculty load: semester VII-½ hour per week per project group.

University of Mumbai
Program Structure for B.E. Chemical Engineering (Revised 2022-2023)
Semester VIII

Course code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CHC801	Modelling Simulation and Optimization	3	-	-	3	-	-	3
CHDO805X	Department Optional Course 5	3	-	-	3	-	-	3
CHDO806X	Department Optional Course 6	3	-	-	3	-	-	3
IO802X	Institute Optional Course 2	3	-	-	3	-	-	3
CHL801	Modelling Simulation and Optimization Lab	-	3	-	-	1.5	-	1.5
CHL802	Software application in Chemical Engineering Lab	-	3	-	-	1.5	-	1.5
CHP801	Major Project II	-	12#	-	-	6	-	6
	Total	12	18	-	12	9	-	21

Course code	Course Name	Examination Scheme								
		Theory					Term Work	Pract /Oral	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in hrs)				
		Test 1	Test 2	Avg						
CHC801	Modelling Simulation and Optimization	20	20	20	80	3	-	-	-	100
CHDO805X	Department Optional Course 5	20	20	20	80	3	-	-	-	100
CHDO806X	Department Optional Course 6	20	20	20	80	3	-	-	-	100
IO802X	Institute Optional Course 2	20	20	20	80	3	-	-	-	100
CHL801	Modelling Simulation and Optimization Lab	-	-	-	-	3	25	25	-	50
CHL802	Software application in Chemical Engineering Lab	-	-	-	-	-	25	-	25	50
CHP801	Major Project II	-	-	-	-	-	50	-	100	150
	Total			80	320	-	175	25	50	650

Department Optional Course 4 (Semester VIII)

Engineering Stream (Course Code)	Technology Stream (Course Code)	Management Stream (Course Code)
Energy System Design (CHDO8041)	Advanced Separation Technology (CHDO8042)	Financial Management (CHDO8043)

Department Optional Course 5 (Semester VIII)

Engineering Stream (Course Code)	Technology Stream (Course Code)	Management Stream (Course Code)
Fuel Cell Electrochemical Engineering (CHDO8051)	1. Biotechnology Technology (CHDO8052) 2. Nanotechnology (CHDO8053)	Chemical Waste Management (CHDO8054)

indicates work load of Learner (Not Faculty), for Major Project; Faculty load: semester VIII – 1 hour per week per project group

University of Mumbai



No. UG/ 54 of 2021

CIRCULAR:-

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

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

MUMBAI – 400 032

21st January, 2021

To

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

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

A.C/4.140/23/07/2020

No. UG/ 54 -A of 2021

MUMBAI-400 032

21st January, 2021

Copy forwarded with Compliments for information to:-

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

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

Copy to :-

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

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

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

for information.

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Biomedical Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

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

Under

FACULTY OF SCIENCE & TECHNOLOGY

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

Preamble

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

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

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

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

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

Member, Academic Council, RRC in Engineering

University of Mumbai

Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform

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

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

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

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

Member, Academic Council, RRC in Engineering

University of Mumbai

Preface By BoS

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

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

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

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

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

1. To prepare the learner with a sound foundation in the Human Physiology, Mathematics, Electronics, Computer Programming and engineering fundamentals.
2. To motivate the learner for self-learning, logical & analytical thinking and use of modern tools for solving real life problems.
3. To impart technical knowledge, competency skills, professional and ethical attitude, good leadership qualities to contribute in the field of healthcare.
4. To prepare the Learner for a successful career in healthcare industry such as sales & marketing, research & development, hospital administration and also to venture into higher education and entrepreneurship.

Board of Studies in Biomedical Engineering

Dr. Manali J. Godse : Chairman

Dr. Prem C. Pandey : Member

Dr. Mita Bhowmick : Member

Dr. Mrunal R. Rane : Member

Dr. Vaibhavi A. Sonetha : Member

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

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
BMC301	Engineering Mathematics – III	3	--	1	3	--	1	4	
BMC302	Human Anatomy and Physiology for Engineers	3		--	3		--	3	
BMC303	Medical Sensors	3	--	--	3	--	--	3	
BMC304	Electronic Circuits Analysis and Design	4	--	--	4	--	--	4	
BMC305	Digital Electronics	3	--	--	3	--	--	3	
BML301	Human Anatomy and Physiology for Engineers Lab	--	2	--	--	1	--	1	
BML302	Medical Sensors Lab	--	2	--	--	1	--	1	
BML303	Electronic Circuits Analysis and Design Lab	--	2	--	--	1	--	1	
BML304	Electronics Lab (SBL)	--	4	--	--	2	--	2	
BMM301	Mini Project – 1 A	--	4 ^s	--	--	2	--	2	
Total		16	14	1	16	07	1	24	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
BMC301	Engineering Mathematics - III	20	20	20	80	3	25	--	125
BMC302	Human Anatomy and Physiology for Engineers	20	20	20	80	3	--	--	100
BMC303	Medical Sensors	20	20	20	80	3	--	--	100
BMC304	Electronic Circuits Analysis and Design	20	20	20	80	3	--	--	100
BMC305	Digital Electronics	20	20	20	80	3	--	--	100
BML301	Human Anatomy and Physiology for Engineers Lab	--	--	--	--	--	25	--	25
BML302	Medical Sensors Lab	--	--	--	--	--	25	25	50
BML303	Electronic Circuits Analysis and Design Lab	--	--	--	--	--	25	25	50
BML304	Electronics Lab (SBL)	--	--	--	--	--	25	25	50
BMM301	Mini Project – 1 A	--	--	--	--	--	25	--	25
Total		--	--	100	400	--	150	75	725

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

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

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
BMC401	Engineering Mathematics – IV	3	--	1	3	--	1	4	
BMC402	Integrated Circuit Design	3	--	--	3	--	--	3	
BMC403	Principles of Control Systems	3	--	--	3	--	--	3	
BMC404	Medical Imaging – I	3	--	--	3	--	--	3	
BMC405	Biomaterials and Artificial Organs	3	--	--	3	--	--	3	
BML401	Integrated Circuit Design Lab	--	2	--	--	1	--	1	
BML402	Principles of Control Systems Lab	--	2	--	--	1	--	1	
BML403	Medical Imaging – I Lab	--	2	--	--	1	--	1	
BML404	Computing Lab (SBL)	--	4	--	--	2	--	2	
BMM401	Mini Project – 1 B	--	4 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	7	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
BMC401	Engineering Mathematics - IV	20	20	20	80	3	25	--	125
BMC402	Integrated Circuit Design	20	20	20	80	3	--	--	100
BMC403	Principles of Control Systems	20	20	20	80	3	--	--	100
BMC404	Medical Imaging – I	20	20	20	80	3	--	--	100
BMC405	Biomaterials and Artificial Organs	20	20	20	80	3	--	--	100
BML401	Integrated Circuit Design Lab	--	--	--	--	--	25	25	50
BML402	Principles of Control Systems Lab	--	--	--	--	--	25	--	25
BML403	Medical Imaging – I Lab	--	--	--	--	--	25	25	50
BML404	Computing Lab (SBL)	--	--	--	--	--	25	25	50
BMM401	Mini Project – 1 B	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	100	750

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

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

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

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract.	Theory	Pract.	Total			
BMC501	Biomedical Instrumentation – I	3	--	3	--	3			
BMC502	Digital Signal Processing	3	--	3	--	3			
BMC503	Microcontrollers and Embedded Systems	4	--	4	--	4			
BMC504	Medical Imaging – II	3	--	3	--	3			
BMDO501 X	Department Optional Course – 1	3	--	3	--	3			
BML501	Biomedical Instrumentation – I Lab	--	2	--	1	1			
BML502	Digital Signal Processing Lab	--	2	--	1	1			
BML503	Microcontrollers and Embedded Systems Lab	--	2	--	1	1			
BML504	Business Communication and Ethics	--	2*+2	--	2	2			
BMM501	Mini Project – 2 A	--	4 ^s	--	2	2			
Total		16	14	16	07	23			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC501	Biomedical Instrumentation – I	20	20	20	80	3	--	--	100
BMC502	Digital Signal Processing	20	20	20	80	3	--	--	100
BMC503	Microcontrollers and Embedded Systems	20	20	20	80	3	--	--	100
BMC504	Medical Imaging – II	20	20	20	80	3	--	--	100
BMDO501 X	Department Optional Course – 1	20	20	20	80	3	--	--	100
BML501	Biomedical Instrumentation – I Lab	--	--	--	--	--	25	25	50
BML502	Digital Signal Processing Lab	--	--	--	--	--	25	25	50
BML503	Microcontrollers and Embedded Systems Lab	--	--	--	--	--	25	25	50
BML504	Business Communication and Ethics	--	--	--	--	--	25	25	50
BMM501	Mini Project – 2 A	--	--	--	--	--	25	--	25
Total		--	--	100	400	--	125	100	725

* Theory class to be conducted for full class

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

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

Sem. V: Department Optional Course – 1

BMDO5011: Principles of Communication Engineering

BMDO5012: Very Large Scale Integration

BMDO5013: Tissue Engineering

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract. /Tut.	Theory	Pract.	Total			
BMC601	Biomedical Instrumentation – II	3	--	3	--	3			
BMC602	Biomedical Digital Image Processing	3	--	3		3			
BMC603	Data Analysis in Healthcare	3	--	3	--	3			
BMC604	Biomechanics, Prosthetics and Orthotics	3	--	3	--	3			
BMDO601 X	Department Optional Course – 2	3	--	3	--	3			
BML601	Biomedical Instrumentation - II	--	2	--	1	1			
BML602	Biomedical Digital Image Processing	--	2	--	1	1			
BML603	Data Analysis in Healthcare	--	2	--	1	1			
BML604	Automation Lab	--	4	--	2	2			
BMM601	Mini Project – 2 B	--	4 ^s	--	2	2			
Total		15	14	15	07	22			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC601	Biomedical Instrumentation - II	20	20	20	80	3	--	--	100
BMC602	Biomedical Digital Image Processing	20	20	20	80	3	--	--	100
BMC603	Data Analysis in Healthcare	20	20	20	80	3	--	--	100
BMC604	Biomechanics, Prosthetics and Orthotics	20	20	20	80	3	--	--	100
BMDO601 X	Department Optional Course – 2	20	20	20	80	3	--	--	100
BML601	Biomedical Instrumentation – II Lab	--	--	--	--	--	25	25	50
BML602	Biomedical Digital Image Processing Lab	--	--	--	--	--	25	25	50
BML603	Data Analysis in Healthcare Lab	--	--	--	--	--	25	--	25
BML604	Automation Lab	--	--	--	--	--	25	25	50
BMM601	Mini Project – 2 B	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	125	100	725

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

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

Sem. VI: Department Optional Course – 2

BMDO6011: Nuclear Medicine

BMDO6012: Advanced Embedded Systems

BMDO6013: Telemedicine

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

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Prac t. Tut.	Theory	Pract.	Total			
BMC701	Biomedical Instrumentation – III	3	--	3	--	3			
BMC702	Machine Learning	3	--	3		3			
BMDO701 X	Department Optional Course – 3	3	--	3	--	3			
BMDO702 X	Department Optional Course – 4	3	--	3	--	3			
BMIO701	Institute Optional Course – 1	3	--	3	--	3			
BML701	Biomedical Instrumentation – III Lab	--	2	--	1	1			
BML702	Machine Learning Lab	--	2	--	1	1			
BML703	Department Optional Course – 3 Lab	--	2	--	1	1			
BMP701	Major Project - I	--	6 [#]	--	3	3			
Total		15	12	15	6	21			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/ oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC701	Biomedical Instrumentation – III	20	20	20	80	3	--	--	100
BMC702	Machine Learning	20	20	20	80	3	--	--	100
BMDO701 X	Department Optional Course – 3	20	20	20	80	3	--	--	100
BMDO702 X	Department Optional Course – 4	20	20	20	80	3	--	--	100
BMIO701	Institute Optional Course – 1	20	20	20	80	3	--	--	100
BML701	Biomedical Instrumentation – III Lab	--	--	--	--	--	25	25	50
BML702	Machine Learning Lab	--	--	--	--	--	25	25	50
BML703	Department Optional Course – 3 Lab	--	--	--	--	--	25	25	50
BMP701	Major Project - I	--	--	--	--	--	50	--	50
Total		--	--	100	400	--	125	75	700

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

Sem. VII: Department Optional Course – 3

BMDO7011: Biological Modeling and Simulation

BMDO7012: Bioinformatics

BMDO7013: IoT based Systems

Sem. VII: Department Optional Course – 4

BMDO7021: Rehabilitation Engineering

BMDO7022: Lasers and Fibre Optics

BMDO7023: Networking and Information Systems in Medicine

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract. /Tut.	Theory	Pract.	Total			
BMC801	Hospital Management	3	--	3	--	3			
BMDO801 X	Department Optional Course – 5	3	--	3	--	3			
BMDO802 X	Department Optional Course – 6	3	--	3	--	3			
BMIO801	Institute Optional Course - 2	3	--	3	--	3			
BML801	Hospital Management Lab	--	2	--	1	1			
BML802	Department Optional Course – 5 Lab	--	2	--	1	1			
BMP801	Major Project - II	--	12 [#]	--	6	6			
Total		12	16	12	8	20			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
BMC801	Hospital Management	20	20	20	80	3	--	--	100
BMDO801 X	Department Optional Course – 5	20	20	20	80	3	--	--	100
BMDO802 X	Department Optional Course – 6	20	20	20	80	3	--	--	100
BMIO801	Institute Optional Course - 2	20	20	20	80	3	--	--	100
BML801	Hospital Management Lab	--	--	--	--	--	25	25	50
BML802	Department Optional Course – 5 Lab	--	--	--	--	--	25	25	50
BMP801	Major Project - II	--	--	--	--	--	100	50	150
Total		--	--	80	320	--	150	100	650

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

Sem. VIII: Department Optional Course – 5

BMDO8011: Robotics in Medicine

BMDO8012: Healthcare Informatics

BMDO8013: Artificial Intelligence in Medicine

Sem. VIII: Department Optional Course – 6

BMDO8021: Biomedical Microsystems

BMDO8022: Medical Device Regulations

BMDO8023: Ergonomics

Students group and load of faculty per week.

Mini Project 1 and 2 :

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

Faculty Load : 1 hour per week per four groups

Major Project 1 and 2 :

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

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

In Semester VIII – 1 hour per week per project group

University of Mumbai



No. UG/ 56 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to the syllabus directly uploaded by the Academic Authority Unit which was accepted by the Academic Council at its meeting held on 11th May, 2017 vide item No.4.307 relating to the revised syllabus as per the (CBCGS) for Bachelor of Engineering (Electronics and Telecommunication Engineering) Second Year w.e.f. AY 2017-18, Third Year w.e.f. AY 2018-19 and Final Year w.e.f. AY 2019-20 (Rev – 2016) from Academic Year 2016-17.

They are hereby informed that the recommendations made by the Board of Studies in Electronics and Telecommunication Engineering at its meeting held on 5th May, 2020 and subsequently made by the Board of Deans at its meeting held on 20th July, 2020 vide item No. 6 have been accepted by the Academic Council at its meeting held on 23rd July, 2020 vide item No. 4.145 and that in accordance therewith, the revised syllabus (Rev-2019 'C' Scheme) for the B.E. in Electronics and Telecommunication Engineering (Sem.III & IV) has been brought into force with effect from the academic year 2020-21. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

21st January, 2021

To

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

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

A.C/4.145/23/07/2020

No. UG/ 56 -A of 2021

MUMBAI-400 032

21st January, 2021

Copy forwarded with Compliments for information to:-

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

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

Copy to :-

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

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

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

for information.

Item No. 45

AC - 23/07/2020

UNIVERSITY OF MUMBAI



Syllabus for Approval

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

Date 02-07-2020

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

Anuradha Majumdar
Dr. Anuradha Majumdar
Dean
Faculty of Science and Technology
University of Mumbai

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

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 ^{\$}	--	--	2	--	2
Total		15	14	2	15	07	2	24

* 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					Term Work	Pract. & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		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
Total		--	--	100	400	--	175	75	750

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 ^s	--	--	2	--	2
Total		15	14	2	15	7	2	24

* 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
Total		--	--	100	400	--	175	100	775

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ECC301	Engineering Mathematics-III	03	-	01*	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Exam Duration (in Hrs.)	Term Work	Pract & Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
ECC301	Engineering Mathematics-III	20	20	20	80	03	25	-	125

* Should be conducted batch wise.

Pre-requisite:

1. FEC101-Engineering Mathematics-I
2. FEC201-Engineering Mathematics-II
3. Scalar and Vector Product: Scalar and vector product of three and four vectors

Course Objectives: The course is aimed

1. To learn the Laplace Transform, Inverse Laplace Transform of various functions and its applications.
2. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill.
3. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra.
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: After successful completion of course 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 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 function.
5. Use matrix algebra to solve the engineering problems.
6. Apply the concepts of vector calculus in real life problems.

Module	Detailed Contents	Hrs.
01	<p>Module: Laplace Transform Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). Evaluation of integrals by using Laplace Transformation.</p> <p>Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.</p>	7
02	<p>Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding 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).</p> <p>Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.</p>	6
03	<p>Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series.</p> <p>Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.</p>	7
04	<p>Module: Complex Variables: 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 to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories</p> <p>Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.</p>	7
05	<p>Module: Linear Algebra: Matrix Theory 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix</p> <p>Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.</p>	6
06	<p>Module: Vector Differentiation and Integral 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 Properties of vector field: Solenoidal and irrotational (conservative) vector</p>	6

fields. 6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus.	
Total	39

References:

1. Advanced engineering mathematics, H.K. Das, S . Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write at least 6 class tutorials on 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 should be considered as mini project in Engineering mathematics. This project should be graded for 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

Internal Assessment Test (20-Marks):

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Question No: 01 will be compulsory and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. Total 04 questions need to be solved.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC302	Electronic Devices & Circuits	3	-	--	3	--	--	3

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECC302	Electronic Devices & Circuits	20	20	20	80	03	--	--	100

Course pre-requisite:

FEC: 102 - Engineering Physics-I
 FEC: 201 - Engineering Physics-II
 FEC:105 - Basic Electrical Engineering

Course Objectives:

1. To explain functionality different electronic devices.
2. To perform DC and AC analysis of small signal amplifier circuits.
3. To analyze frequency response of small signal amplifiers.
4. To compare small signal and large signal amplifiers.
5. To explain working of differential amplifiers and it's applications in Operational Amplifiers

Course Outcomes:

After successful completion of the course student will be able to:

1. Know functionality and applications of various electronic devices.
2. Explain working of various electronics devices with the help of V-I characteristics.
3. Derive expressions for performance parameters of BJT and MOSFET circuits.
4. Evaluate performance of Electronic circuits (BJT and MOSFET based).
5. Select appropriate circuit for given application.
6. Design electronic circuit (BJT, MOSFET based) circuits for given specifications.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction of Electronic Devices	05
	1.1	Study of pn junction diode characteristics & diode current equation. Application of zener diode as a voltage regulator.	
	1.2	Construction, working and characteristics of BJT, JFET, and E-MOSFET	
2.0		Biasing Circuits of BJTs and MOSFETs	06
	2.1	Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias)	
	2.2	DC load line and region of operation for MOSFETs. Analysis and design of biasing circuits for JFET (self bias and voltage divider bias), E-MOSFET (Drain to Gate bias & voltage divider bias).	
3.0		Small Signal Amplifiers	06
	3.1	Concept of AC load line and Amplification, Small signal analysis (Z_i , Z_o , A_v and A_i) of CE amplifier using hybrid pi model.	
	3.2	Small signal analysis (Z_i , Z_o , A_v) of CS (for E-MOSFET) amplifiers.	
	3.3	Introduction to multistage amplifiers.(Concept, advantages & disadvantages)	
4.0		Frequency response of Small signal Amplifiers:	08
	4.1	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance.	
	4.2	High and low frequency analysis of CE amplifier.	
	4.3	High and low frequency analysis of CS (E-MOSFET) amplifier.	
5.0		Large Signal Amplifiers:	06
	5.1	Difference between small signal & large signal amplifiers. Classification and working of Power amplifier	
	5.2	Analysis of Class A power amplifier (Series fed and transformer coupled).	
	5.3	Transformer less Amplifier: Class B power amplifier. Class AB output stage with diode biasing	
	5.4	Thermal considerations and heat sinks.	
6.0		Introduction to Differential Amplifiers	08
	6.1	E-MOSFET Differential Amplifier, DC transfer characteristics, operation with common mode signal and differential mode signal	
	6.2	Differential and common mode gain, CMRR, differential and common mode Input impedance.	
	6.3	Two transistor (E-MOSFET) constant current source	
		Total	39

Text books:

1. D. A. Neamen, "Electronic Circuit Analysis and Design," Tata McGraw Hill, 2nd Edition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits Theory and Applications," International Version, OXFORD International Students, 6th Edition
3. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.

References:

1. Boylestad and Nashelsky, "Electronic Devices and Circuits Theory," Pearson Education, 11th Edition.
2. A. K. Maini, "Electronic Devices and Circuits," Wiley.
3. T. L. Floyd, "Electronic Devices," Prentice Hall, 9th Edition, 2012.
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 3rd Edition
5. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

NPTEL/ Swayam Course:

1. Course: Analog Electronic Circuit By Prof. Shouribrata chatterjee (IIT Delhi);
https://swayam.gov.in/nd1_noc20_ee89/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC303	Digital System Design	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
ECC303	Digital System Design	20	20	20	80	03	--	--	100

Course Pre-requisite:

FEC105 – Basic Electrical Engineering

Course Objectives:

1. To understand number system representations and their inter-conversions used in digital electronic circuits.
2. To analyze digital logic processes and to implement logical operations using various combinational logic circuits.
3. To analyze, design and implement logical operations using various sequential logic circuits.
4. To study the characteristics of memory and their classification.
5. To learn basic concepts in VHDL and implement combinational and sequential circuits using VHDL.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand types of digital logic, digital circuits and logic families.
2. Analyze, design and implement combinational logic circuits.
3. Analyze, design and implement sequential logic circuits.
4. Develop a digital logic and apply it to solve real life problems.
5. Classify different types of memories and PLDs.
6. Simulate and implement basic combinational and sequential circuits using VHDL/Verilog.

Module No.	Unit No.	Topics	Hrs.
1.0		Number Systems and Codes	04
	1.1	Review of Binary, Octal and Hexadecimal Number Systems, their inter-conversion, Binary code, Gray code and BCD code, Binary Arithmetic, Addition, Subtraction using 1's and 2's Complement	04
2.0		Logic Family and Logic Gates	05
	2.1	Difference between Analog and Digital signals, Logic levels, TTL and CMOS Logic families and their characteristics	03
	2.2	Digital logic gates, Universal gates, Realization using NAND and NOR gates, Boolean Algebra, De Morgan's Theorem	02
3.0		Combinational Logic Circuits	12
	3.1	SOP and POS representation, K-Map up to four variables and Quine-McClusky method for minimization of logic expressions	04
	3.2	Arithmetic Circuits: Half adder, Full adder, Half Subtractor, Full Subtractor, Carry Look ahead adder and BCD adder, Magnitude Comparator	04
	3.3	Multiplexer and De-Multiplexer: Multiplexer operations, cascading of Multiplexer, Boolean function implementation using MUX, DEMUX and basic gates, Encoder and Decoder	04
4.0		Sequential Logic Circuits	12
	4.1	Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Conversion of flip flops, Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register	04
	4.2	Counters: Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N, BCD Counter	04
	4.3	Applications of Sequential Circuits: Frequency division, Ring counter, Johnson counter, Introduction to design of Moore and Mealy circuits	04
5.0		Different Types of Memories and Programmable Logic Devices	04
	5.1	Classification and Characteristics of memory, SRAM, DRAM, ROM, PROM, EPROM and Flash memories	02
	5.2	Introduction: Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic (PAL)	02
6.0		Introduction to VHDL	02
	6.1	Basics of VHDL/Verilog Programming, Design and implementation of adder, subtractor, multiplexer and flip flop using VHDL/Verilog	02
		Total	39

Text Books:

1. John F. Warkerly, "Digital Design Principles and Practices", Pearson Education, Fifth Edition (2018).
2. Morris Mano, Michael D. Ciletti, "Digital Design", Pearson Education, Fifth Edition (2013).
3. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Education, Forth Edition (2010).
4. A. Anand Kumar, "Fundamentals of Digital Circuits", PHI, Fourth Edition (2016).
5. Volnei A. Pedroni, "Digital Electronics and Design with VHDL" Morgan Kaufmann Publisher, First Edition (2008).
6. Stephen Brown & Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", Third Edition, MGH (2014).

Reference Books:

1. Thomas L. Floyd, "Digital Fundamentals", Pearson Prentice Hall, Eleventh Global Edition (2015).
2. Mandal, "Digital Electronics Principles and Applications", McGraw Hill Education, First Edition (2010).
3. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss "Digital Systems Principles and Applications", Ninth Edition, PHI (2009).
4. Donald P. Leach / Albert Paul Malvino/Gautam Saha, "Digital Principles and Applications", The McGraw Hill, Eight Edition (2015).
5. Stephen Brown & Zvonko Vranesic, "Fundamentals of Digital Logic Design with VHDL", Second Edition, TMH (2009).
6. J. Bhasker, "A Verilog HDL Primer", Star Galaxy Press, Third Edition (1997).

NPTEL / Swayam Course:

1. Course: Digital Circuits By Prof. Santanu Chattopadhyay (IIT Kharagpur);
https://swayam.gov.in/nd1_noc20_ee70/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC304	Network Theory	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme								
		Theory Marks					Exam. Duration (in Hrs)	Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test2	Avg. of Test 1 and Test 2						
ECC304	Network Theory	20	20	20	80	03	25	--	125	

Course Pre-requisite:

1. FEC105 - Basic Electrical Engineering
2. FEC201 - Engineering Mathematics II

Course Objectives:

1. To evaluate the Circuits using network theorems.
2. To analyze the Circuits in time and frequency domain.
3. To study network Topology, network Functions and two port networks.
4. To synthesize passive network by various methods.

Course Outcomes:

After successful completion of the course student will be able to:

1. Apply their knowledge in analyzing Circuits by using network theorems.
2. Apply the time and frequency method of analysis.
3. Evaluate circuit using graph theory.
4. Find the various parameters of two port network.
5. Apply network topology for analyzing the circuit.
6. Synthesize the network using passive elements.

Module No.	Unit No.	Topics	Hrs.
1.0		Electrical circuit analysis	08
	1.1	Circuit Analysis: Analysis of Circuits with and without dependent sources using generalized loop and node analysis, super mesh and super node analysis technique Circuit Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems (Use only DC source).	
	1.2	Magnetic circuits: Concept of Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using mesh analysis (for Two Loops only).	
2.0		Graph Theory	06
	2.1	Objectives of graph theory, Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced Incident matrix, Tieset matrix, f-cutset matrix.	
	2.2	Relationship between sub matrices A, B & Q. KVL & KCL using matrix.	
3.0		Time and frequency domain analysis	07
3.0	3.1	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values. Solution using first order and second order differential equation with step signals.	
	3.2	Frequency domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor. Solution using second order equation for step signal.	
4.0		Network functions	06
	4.1	Network functions for the one port and two port networks, driving point and transfer functions, Poles and Zeros of Network functions, necessary condition for driving point functions, necessary condition for transfer functions, calculation of residues by graphical methods, testing for Hurwitz polynomial.	
	4.2	Analysis of ladder & symmetrical lattice network (Up to two nodes or loops)	
5.0		Two port Networks	05
	5.1	Parameters: Open Circuits, short Circuit, Transmission and Hybrid parameters, relationship among parameters, conditions for reciprocity and symmetry.	
	5.2	Interconnections of Two-Port networks T & π representation.	
6.0		Synthesis of RLC circuits	07
	6.1	Positive Real Functions: Concept of positive real function, necessary and sufficient conditions for Positive real Functions.	
	6.2	Synthesis of LC, RC & RL Circuits: properties of LC, RC & RL driving point functions, LC, RC & RL network Synthesis in Cauer-I & Cauer-II, Foster-I & Foster-II forms (Up to Two Loops only).	
		Total	39

Textbooks:

1. Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd ed. ,1966.
2. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000.

Reference Books:

1. A. Chakrabarti, "*Circuit Theory*", Dhanpat Rai & Co., Delhi, 6th Edition.
2. A. Sudhakar, Shyammohan S. Palli "Circuits and Networks", Tata McGraw-Hill education.
3. Smarajit Ghosh "Network Theory Analysis & Synthesis", PHI learning.
4. K.S. Suresh Kumar, "Electric Circuit Analysis" Pearson, 2013.
5. D. Roy Choudhury, "Networks and Systems" , New Age International, 1998.

NPTEL / Swayam Course:

1. Course: Basic Electrical Circuits By Prof. Nagendra Krishnapura (IIT Madras);
https://swayam.gov.in/nd1_noc20_ee64/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Term Work (25-Marks):

At least **10 assignments** covering entire syllabus must be given during the "**Class Wise Tutorial**". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per "**Credit and Grading System**" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC305	Electronic Instrumentation & Control Systems	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Exam Duration (in Hrs.)	Term Work	Practical And Oral	Total
		Internal assessment			Avg. of Test 1 and Test 2					
		Test1	Test2							
ECC305	Electronic Instrumentation & Control Systems	20	20	20	80	03	--	--	100	

Course pre-requisites:

1. FEC105 – Basic Electrical Engineering

Course Objectives:

1. To provide basic knowledge about the various sensors and transducers
2. To provide fundamental concepts of control system such as mathematical modeling, time response and Frequency response.
3. To develop concepts of stability and its assessment criteria.

Course Outcomes:

After successful completion of the course student will be able to:

1. Identify various sensors, transducers and their brief performance specification.
2. Understand the principle of working of various transducer used to measure temperature, displacement, level, pressure and their application in industry
3. Determine the models of physical systems in forms suitable for use in the analysis and design of control systems.
4. Obtain the transfer functions for a given Control system.
5. Understand the analysis of systems in time domain and frequency domain.
6. Predict stability of given system using appropriate criteria.

Module No.	Unit No.	Topics	Hrs.
1		Principle of Measurement, Testing and Measuring instruments	04
	1.1	Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.	
	1.2	Measurement of Resistance: Kelvin's double bridge, Wheatstone bridge and Mega ohm bridge Measurement of Inductance: Maxwell bridge and Hey bridge Measurement of Capacitance: Schering bridge	
2		Sensors and Transducers	06
	2.1	Basics of sensors and Transducers-Active and passive transducers, characteristics and selection criteria of transducers	
	2.2	Displacement and pressure- Potentiometers, pressure gauges, linear Variable differential transformers (LVDT) for measurement of pressure and displacement strain gauges	
	2.3	Temperature Transducers- Resistance temperature detectors (RTD). Thermistors and thermocouples, their ranges and applications	
3		Introduction to control system Analysis	08
	3.1	Introduction: Open and closed loop systems, example of control systems	
	3.2	Modelling: Modelling, Transfer function model	
	3.3	Block diagram reduction techniques and Signal flow graph	
4		Response of control system	04
	4.1	Dynamic Response: Standard test signals, transient and steady state behavior of first and second order systems, steady state errors in feedback control systems and their types	
	4.2	Concept of lag and lead compensator.	
5		Stability Analysis in Time Domain	08
	5.1	Concept of stability: Routh and Hurwitz stability criterion	
	5.2	Root locus Analysis: Root locus concept, general rules for constructing root-locus, root locus analysis of control system	
6		Stability Analysis in frequency domain	09
	6.1	Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins	
	6.2	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot. Frequency response analysis of RC, RL, RLC circuits	
	6.3	Nyquist Criterion: Concept of Polar plot and Nyquist plot, Nyquist stability criterion, gain and phase margin	
Total			39

Textbooks:

1. A.K. Sawhney, “*Electrical & Electronic Measurement & Instrumentation*” – DRS .India
2. B.C Nakra, K.K. Cahudhary, *Instrumentation Measurement and Analysis*, Tata Mc Graw Hill.
3. W.D. Cooper, “*Electronic Instrumentation And Measuring Techniques*” –PHI
4. Nagrath, M.Gopal, “*Control System Engineering*”, Tata McGrawHill.
5. Rangan C. S., Sarma G. R. and Mani V. S. V., “*Instrumentation Devices And Systems*”, Tata McGraw-Hill, 2nd Ed.,2004.
6. K.Ogata, “*Modern Control Engineering*, Pearson Education”, 3rd edition.

Reference Books:

1. Helfrick&Copper, “*Modern Electronic Instrumentation & Measuring Techniques*” –PHI
2. M.M.S. Anand, “*Electronic Instruments and instrumentation Technology*”.
3. Gopal M., “*Control Systems Principles and Design*”, Tata McGraw Hill Publishing Co. Ltd.New Delhi, 1998.
4. Benjamin C.Kuo, “*Automatic Control Systems*, Pearson education”, 7th edition
5. Doebelin E.D., *Measurement system*, Tata Mc Graw Hill., 4th ed, 2003.Madan Gopal, “*Control Systems Principles and Design*”, Tata McGraw hill, 7th edition,1997.
6. Norman, “*Control System Engineering*”, John Wiley & sons, 3rd edition.

NPTEL/ Swayam Course:

1. Course: Control Systems By Prof. C. S. Shankar Ram (IIT Madras);
https://swayam.gov.in/nd1_noc20_ee90/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Practical and Oral	Total
		Internal assessment			Test 1				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	25	25	50	

Course Objectives:

1. To make students familiar with equipments and measuring instruments used to perform Electronics Devices and Circuits laboratory work.
2. To provide hands on experience to develop laboratory setup for performing given experimental using various equipments, electronic devices and measuring instruments.
3. To develop an ability among students to gather appropriate data and analyse the same to relate theory with practical.
4. To develop trouble shooting abilities among students.

Course Outcomes:

After successful completion of the course students will be able to:

1. Know various equipments, electronics devices and components, and measuring instruments used to perform laboratory work.
2. Students will be able to explain functionality of various equipments, electronics devices and components and neasu6 instruments used to perform laboratory work.
3. Students will be able connect various equipments, devices, components and measuring devices using bread board as per the circuit diagram for experiment to be performed.
4. Students will able to perform experiment to gather appropriate data.
5. Students will able to analyze data obtained from experiment to relate theory with experiment results.
6. Students will able to prepare laboratory report (Journal) to summarise the outcome each experiment.

Laboratory plan:

Maximum of 10 practicals including minimum 2 to 3 simulations should be conducted.

Suggested list of experiments:

1. To study of pn junction diode characteristics.
2. To study zener as a voltage regulator.
3. To study characteristics of CE configuration.
4. To study BJT biasing circuits.
5. To study BJT as CE amplifier.
6. To study frequency response of CE amplifier.
7. To study EMOSFET biasing circuits.
8. Simulation experiment on study of CS amplifier.
9. Simulation experiment on study frequency response of CS amplifier.
10. Simulation experiment on study of differential amplifier.
11. Simulation experiment on multistage amplifier.

Term Work: At least 10 Experiments including not more than 03 simulations covering entire syllabus must be given during the “Laboratory session batch wise”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time. The grades will be converted to marks as per “**Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. The practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL302	Digital System Design Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam.			
		Test 1	Test 2	Avg.				
ECL302	Digital System Design Lab	--	--	--	--	25	--	25

Course objectives:

1. To get familiarise with basic building blocks of Digital System Design and verify the operation of various digital ICs.
2. To train students to design and implementation of combinational circuits.
3. To instruct students on how to design and implement sequential circuits.
4. To introduce simulation software like VHDL/Verilog to design basic digital circuits.

Course outcomes:

Learners will be able to ...

1. Identify various Digital ICs and basic building blocks of digital system design
2. Design and implement combinational circuits like adder, subtractor, multiplexer, code converters etc.
3. Identify and understand working of various types of flip flops and their inter conversions.
4. Design and implement basic sequential circuits such as counters, registers etc.
5. Acquire basic knowledge of VHDL/Verilog basic programming.

Suggested list of experiments:

1. Simplification of Boolean functions.
2. Design AND, OR, NOT, EXOR, EXNOR gates using Universal gates: NAND and NOR.
3. Implement digital circuits to perform Binary to Gray and Gray to Binary operations.
4. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
5. Design and implement BCD adder using 4-bit Binary Adder IC-7483.
6. Implement logic equations using Multiplexer.
7. Verify encoder and decoder operations.

8. Design and implement Magnitude Comparator.
9. Verify truth table of different types of flip flops.
10. Flip flop conversions JK to D, JK to T and D to TFF.
11. Design asynchronous/synchronous MOD N counter using IC7490.
12. Verify different counter operations.
13. Write VHDL/Verilog simulation code for different logic gates.
14. Write VHDL/Verilog simulation code for combinational and sequential circuits.
15. Write VHDL/Verilog simulation code for 4:1 Multiplexer, 2 to 4 line binary decoder.

Term Work:

At least 08 experiments covering the entire syllabus must be given “**Batch Wise**”. Out of these, **06 hardware experiments**, to be done strictly on breadboard and **at least 02 software experiments** using VHDL/Verilog. Teacher should refer the suggested list of experiments and can design additional experiments to acquire practical design skills. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time. The grades will be converted to marks as per “**Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Pract.	Tut.	Total
ECL303	Electronic Instrumentation & Control Systems Lab.	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical & Oral	Total
		Internal assessment		End Sem. Exam				
ECL303	Electronic Instrumentation & Control Systems Lab.	--	--	--	--	25	--	25

Course Objectives:

1. To experimentally verify the principle and characteristics of various transducers and measurement of resistance and inductance.
2. To make students understand the construction and the working principle of various transducers used for Displacement measurement, Temperature measurement and Level measurement.
3. To examine steady-state and frequency response of the Type 0, 1, and 2 systems.
4. To examine steady-state and frequency response of first and second order electrical systems.
5. To inspect stability analysis of system using Root locus, Bode plot, polar plot and Nyquist plot.

Course Outcomes:

After successful completion of the course student will be able to:

1. Plot and validate the performance characteristics of transducers.
2. Validate the characteristics of various temperature, pressure and level transducers.
3. Plot frequency response of first-order electrical system.
4. Plot time response of second-order electrical system and calculate the steady-state error.
5. Validate the effect of damping factor on the response of second order system.
6. Inspect the frequency response specifications of systems by using bode-plot, Polar plot, Nyquist-plot techniques, and comment on the stability of system

List of experiments:

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Designing AC bridge Circuit for capacitance measurement.
3. Study and characteristics of Resistive Temperature Detector (RTD).
4. Study of Linear Variable Differential Transformer (LVDT)
5. To plot the effect of time constant on first-order systems response.
6. To plot the frequency response of first-order System
7. To plot the time response of second-order systems
8. To plot the frequency response of second-order System
9. To Examine Steady State Error for Type 0, 1, 2 System
10. To study the performance of Lead and Lag Compensator
11. To inspect the relative stability of systems by Root-Locus using Simulation Software.
12. To determine the frequency specification from Polar plot of system
13. To inspect the stability of system by Nyquist plot using Simulation software.
14. To inspect the stability of system by Bode plot using Simulation software.
15. Any other experiment based on syllabus which will help students to understand topic/concept.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “Laboratory session batch wise”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time. The grades will be converted to marks as per “**Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL304	Skill Lab: C++ and Java Programming	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Practical And Oral	Total
		Internal assessment			Avg. Of Test 1 and Test 2				
		Test 1	Test 2						
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	25	25	50	

Note: Before performing practical 'Necessary Theory' will be taught by concern faculty

Course Pre-requisites:

1. FEL204 - C-Programming

Course Objectives:

1. Describe the principles of Object Oriented Programming (OOP).
2. To understand object-oriented concepts such as data abstraction, encapsulation, inheritance and polymorphism.
3. Utilize the object-oriented paradigm in program design.
4. To lay a foundation for advanced programming.
5. Develop programming insight using OOP constructs.

Course Outcomes:

After successful completion of the course student will be able to:

1. Describe the basic principles of OOP.
2. Design and apply OOP principles for effective programming.
3. Develop programming applications using OOP language.
4. Implement different programming applications using packaging.
5. Analyze the strength of OOP.
6. Percept the Utility and applicability of OOP.

Module No.	Unit No.	Topics	Hrs.
1.0		C++ Overview	08
	1.1	Need of Object-Oriented Programming (OOP), Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP and C++ as object oriented programming language.	
	1.2	C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members.	
2.0		C++ Control Structures	08
	2.1	Branching - If statement, If-else Statement, Decision. Looping – while, do-while, for loop Nested control structure - Switch statement, Continue statement, Break statement.	
	2.2	Array - Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array.	
3.0		Object-Oriented Programming using C++	12
	3.1	Operator Overloading - concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Function - Function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function. Constructor - Definition, Types of Constructor, Constructor Overloading, Destructor.	
	3.2	Inheritance - Introduction, Types of Inheritance, Inheritance, Public and Private Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Visibility Modes Public, Private, Protected and Friend, Aggregation, Classes Within Classes. Deriving a class from Base Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Polymorphism - concept, relationship among objects in inheritance hierarchy, Runtime & Compile Time Polymorphism, abstract classes, Virtual Base Class.	
4.0		Introduction to Java	06
	4.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	4.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
5.0		Inheritance, Polymorphism, Encapsulation using Java	10

	5.1	Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. String: String Class and Methods in Java.	
	5.2	Inheritances: Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
6.0		Exception Handling and Applets in Java	08
	6.1	Exception Handling: fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). Managing I/O: Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, and Print Writer class. Threading: Introduction, thread life cycle, Thread States: new, runnable, Running, Blocked and terminated, Thread naming, thread join method, Daemon thread	
	6.2	Applet: Applet Fundamental, Applet Architecture, Applet Life Cycle, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Applet and Application Program.	
		Total	52

Suggested list of Experiments:

Note: Before performing practical necessary Theory will be taught by concern faculty

Sr.No	Write C++ Program to
1	Add Two Numbers
2	Print Number Entered by User
3	Swap Two Numbers
4	Check Whether Number is Even or Odd
5	Find Largest Number Among Three Numbers
6	Create a simple class and object.
7	Create an object of a class and access class attributes
8	Create class methods
9	Create a class to read and add two distance
10	Create a class for student to get and print details of a student.
11	Demonstrate example of friend function with class
12	Implement inheritance.

Sr. No.	Write JAVA Program to
1	Display addition of number
2	Accept marks from user, if Marks greater than 40, declare the student as "Pass" else "Fail"
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.
11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'Runnable' interface or creating 'Thread Class.
15	Demonstrate Hello World Applet Example

Textbooks:

1. Bjarne Stroustrup, "The C++ Programming language", Third edition, Pearson Education.
2. Yashwant Kanitkar, "Let Us Java", 2nd Edition, BPB Publications.
3. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, Edition: 2015
4. Deitel, "C++ How to Program", 4th Edition, Pearson Education.

Reference Books:

1. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, Ninth Edition.
2. Java: How to Program, 8/e, Dietal, PHI.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Languageser Guide", Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary "Programming in Java", Oxford University Press, 2010.

Skill-Enhancement:

1. The students should be trained to code in Eclipse (an industry accepted software tool). Also, for a given problem statement, there is need to include external library files (other than JDK files). Moreover, the students need to be trained on Maven (a build tool).
2. Real-life mini-problem statements from software companies (coming in for placement) to be delegated to groups of 3-4 students each and each group to work on the solution for 8-12 hours (last 2 lab sessions).

Software Tools:

1. Raptor-Flowchart Simulation:<http://raptor.martincarlisle.com/>
2. Eclipse: <https://eclipse.org/>
3. Netbeans:<https://netbeans.org/downloads/>
4. CodeBlock:<http://www.codeblocks.org/>
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Term Work:

At least **12** experiments (**06 experiments** each on **C++** and **JAVA**) covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every Experiments are graded from time to time.

The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encouraged to share their experiments codes on online repository. Practical exam should cover all **12** experiments for examination.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM301	Mini Project 1A	--	04 ^{\$}	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. Of Test1 and Test2				
ECM301	Mini Project 1A	--	--	--	--	25	25	50

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

Objectives

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.

Outcome: At the end of the course learners 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. Analyse 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 life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- 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.
- 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.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- 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.
- 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.

Guidelines for Assessment of Mini Project:

Term Work

- 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.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- 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.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- 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.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project 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 **one year, project**, 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 **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- 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 organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project 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

NOTE: For Electronics & Telecommunication Engineering we recommend following syllabus for Mini-Project 1A, in case it is half-year project.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM301	Mini Project 1A: Analog & Digital Circuit Design based Projects	--	04 ^{\$}	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Total	
		Internal assessment			End Sem. Exam				
Test1	Test2	Avg. Of Test1 and Test2							
ECM301	Mini Project 1A: Analog & Digital Circuit Design based Projects	--	--	--		--	25	25	50

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

Course Pre-requisite:

1. FEC105 - BEE

Course Objectives:

1. To make students familiar with the basics of electronic devices and circuits, electrical circuits and digital systems
2. To familiarize the students with the designing and making of Printed circuit boards(PCB)
3. To improve the knowledge of electronics hardware among students

Course outcomes:

After successful completion of the course student will be able to:

1. Create the electronics circuit for particular application/experiment.
2. Design and simulate the circuits by putting together the analog and digital components
3. Learn the technique of soldering and circuit implementation on general purpose printed circuit board (GPP).
4. Realize the PCB design process and gain up-to-date knowledge of PCB design software.
5. Utilize the basic electronic tools and equipment's (like DMM, CRO, DSO etc.)
6. Analysis of hardware fault (Fault detection and correction)

Module No.	Unit No.	Topics	Hrs.
1.0		Identification and Designing of Circuit	08
	1.1	Identification of particular application with understanding of its detail operation. Study of necessary components and devices required to implement the application.	
	1.2	Designing the circuit for particular application (either analog , digital, electrical , analog and digital, etc)	
2.0		Software simulation and Implementation on GPP	12
	2.1	Simulation of circuit for particular application using software's to verify the expected results	
	2.2	Implementation of verified circuit on general purpose printed circuit board (GPP). Now Verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
3.0		PCB design and optimization	08
	3.1	Design the circuit by placing components using PCB design software's.	
	3.2	Reduce the size of PCB by varying the position of components or devices for optimize use of copper clad material	
4.0		Implementation of PCB	08
	4.1	Transfer the designed PCB on Copper clad either by using dark room or taking printout on glossy paper, etc (use available suitable method).	
	4.2	Perform Etching and then Soldering.	
5.0		Detection of Hardware faults and Result verification	08
	5.1	Identify the hardware faults in designed circuit and subsequently rectify it	
	5.2	Now again verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
6.0		Understanding the Troubleshooting	08
	6.1	Understand the trouble shooting by removing some wired connection.	
	6.2	Understand the trouble shooting of track. Troubleshoot the faculty components or devices	
		Total	52

NOTE: During 1st week or within 1-month of the beginning of the semester, following topics related to ADC and DAC should be covered as theoretical concepts.

- a. **Performance specifications of ADC, single ramp ADC, ADC using DAC, dual slope ADC, successive approximation ADC.**
- b. **Performance specifications of DAC, binary weighted resistor DAC, R/2R ladder DAC, inverted R/2R ladder DAC.**

Reference books:

1. Schultz Mitchel E., "*Grob's Basic Electronics*", McGraw-Hill Education; 10th edition, 25 October , 2006.
2. Charles Platt, "*Make Electronics: Learning by discovery*", O'Reilly; 2nd edition, 18 September , 2015.
3. Forrest M Mims III, "*Getting started in Electronics*", Book Renter, Inc.; 3rd edition , 1 January 2000.

4. R S Khandpur, "*Printed circuit board*", McGraw-Hill Education; 1st edition, 24 February , 2005.
5. Kraig Mitzner, "*Complete PCB Design Using OrCAD Capture and PCB Editor*", Academic Press; 2nd edition , 20 June 2019.

Suggested Software tools:

1. LTspice: <https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#>
2. Eagle : <https://www.autodesk.in/products/eagle/overview>
3. OrCAD: <https://www.orcad.com/>
4. Multisim : <https://www.multisim.com/>
5. Webbench: <http://www.ti.com/design-resources/design-tools-simulation/webench-power-designer.html>
6. Tinkercad : <https://www.tinkercad.com/>

Online Repository:

1. <https://www.electronicsforu.com>
2. <https://circuitdigest.com>
3. <https://www.electronicshub.org>

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	TW/Pract	Tut.	Total
ECC401	Engineering Mathematics-IV	03	-	01*	03	-	01	04

Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (in Hrs.)	Term Work	Pract & Oral	Total
		Internal Assessment			End Sem exam					
Test1	Test2	Avg. of Test 1 & 2								
ECC401	Engineering Mathematics-IV	20	20	20	80	03	25	-	125	

* Should be conducted batch wise.

Pre-requisite:

1. FEC101-Engineering Mathematics-I
2. FEC201-Engineering Mathematics-II
3. ECC301-Engineering Mathematics-III & Binomial Distribution.

Course Objectives: The course is aimed:

1. To understand line and contour integrals and expansion of complex valued function in a power series.
2. To understand the basic techniques of statistics for data analysis, Machine learning and AI.
3. To understand probability distributions and expectations.
4. To understand the concepts of vector spaces used in the field of machine learning and engineering problems.
5. To understand the concepts of Quadratic forms and Singular value decomposition.
6. To understand the concepts of Calculus of Variations.

Course Outcomes:

On successful completion of course learner/student will be able to:

1. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
2. Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning and AI.
3. Apply the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
4. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
5. Use the concept of Quadratic forms and Singular value decomposition which are very useful tools in various Engineering applications.
6. Find the extremals of the functional using the concept of Calculus of variation.

Module	Detailed Contents	Hrs.
01	<p>Module: Complex Integration</p> <p>1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).</p> <p>1.2 Taylor's and Laurent's series (without proof).</p> <p>1.3 Definition of Singularity, Zeroes, poles of $f(z)$, Residues, Cauchy's Residue Theorem (without proof).</p> <p>Self-learning Topics: Application of Residue Theorem to evaluate real integrations, Z- Transform.</p>	7
02	<p>Module: Statistical Techniques</p> <p>2.1 Karl Pearson's Coefficient of correlation (r).</p> <p>2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks)</p> <p>2.3 Lines of regression.</p> <p>2.4 Fitting of first and second degree curves.</p> <p>Self-learning Topics: Covariance, fitting of exponential curve.</p>	6
03	<p>Module: Probability Distributions</p> <p>1.1 Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function.</p> <p>3.2 Expectation, mean and variance.</p> <p>3.3 Probability distribution: Poisson & normal distribution.</p> <p>Self-learning Topics: Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.</p>	7
04	<p>Module: Linear Algebra: Vector Spaces:-</p> <p>4.1 Vectors in n-dimensional vector space, norm, dot product, The CauchySchwarz inequality (with proof), Unit vector.</p> <p>4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors.</p> <p>4.3 Vector spaces over real field, subspaces.</p> <p>Self-Learning Topics:- Linear combinations, linear Dependence and Independence, QR decomposition.</p>	6
05	<p>Module: Linear Algebra: Quadratic Forms</p> <p>5.1 Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation.</p> <p>5.2 Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value-class of a quadratic form-Definite, Semidefinite and Indefinite.</p> <p>5.3 Reduction of Quadratic form to a canonical form using congruent transformations.</p> <p>5.4 Singular Value Decomposition.</p> <p>Self-learning Topics: Orthogonal Transformations, Applications of Quadratic forms and SVD in Engineering.</p>	7

06	<p>Module: Calculus of Variations: 6.1 Euler- Lagrange equation (Without Proof), When F does not contain y, When F does not contain x, When F contains x, y, y'. 6.2 Isoperimetric problems- Lagrange Method. 6.3 Functions involving higher order derivatives: Rayleigh-Ritz Method.</p> <p>Self-Learning Topics:- Brachistochrone Problem, Variational Problem, Hamilton Principle, Principle of Least action , Several dependent variables.</p>	6
Total		39

References:

1. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
4. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
- 5 Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
6. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
7. Beginning Linear Algebra Seymour Lipschutz Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Term Work (25-Marks):

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write at least 6 class tutorials on 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 should be considered as mini project in Engineering mathematics. This project should be graded for 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

Internal Assessment Test (25-Marks):

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Question No: 01 will be compulsory and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. Total 04 questions need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC402	Micro-controllers	3	-	--	3	-	--	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of Test 1 and Test 2					
ECC402	Micro-controllers	20	20	20	80	03	-	-	100

Course Pre-requisites:

1. ECC303 - Digital System Design

Course objectives:

1. To develop background knowledge of Computer and its memory System.
2. To understand architecture of 8051 and ARM7 core.
3. To write programs for 8051 microcontrollers.
4. To understand design of Microcontroller Applications.

Course outcomes:

After successful completion of the course student will be able to:

1. Understand Computer and its memory System,
2. Understand the detailed architecture of 8051 and ARM7 Core.
3. Write programs for 8051 microcontrollers.
4. Design an applications using microcontroller.

Module No.	Unit No.	Topics	Hrs
1		Overview of Microprocessor based System	5
	1.1	Overview of microcomputer systems and their building blocks, Memory Interfacing, Steps taken by the microprocessor to fetch and executes an instruction from the memory	
	1.2	Concepts of Program counter register, Reset, Stack and stack pointer , Subroutine, Interrupts and Direct Memory Access	
	1.3	Concept of RISC & CISC Architecture	
	1.4	Harvard & Von Neumann Architecture	
2		The Memory Systems	4
	2.1	Classification of Memory : Primary and Secondary	
	2.2	Types of Semiconductor memories	
	2.3	Cache Memory	
	2.4	Virtual Memory Concept with Memory Management Unit with Segmentation and Paging (Address Translation Mechanism)	
3		8051 Microcontroller	8
	3.1	Comparison between Microprocessor and Microcontroller	
	3.2	Features, architecture and pin configuration	
	3.3	CPU timing and machine cycle	
	3.4	Input / Output ports	
	3.5	Memory organization	
	3.6	Counters and timers	
	3.7	Interrupts	
	3.8	Serial data input and output	
4		8051 Assembly Language Programming and Interfacing	9
	4.1	Addressing modes	
	4.2	Instruction set	
	4.3	Need of Assembler & Cross Assemble, Assembler Directives	
	4.4	Programs related to: arithmetic, logical, delay subroutine , input, output, timer, counters, port, serial communication, and interrupts	
	4.5	Interfacing with LEDs, Relay and Keys	
5		ARM7	8
	5.1	Introduction & Features of ARM 7	
	5.2	Concept of Cortex-A, Cortex-R and Cortex-M	
	5.3	Architectural inheritance, Pipelining	
	5.4	Programmer's model	
	5.5	Brief introduction to exceptions and interrupts handling	
	5.6	Instruction set: Data processing, Data Transfer, Control flow	
6		Study 8 bit microcontroller Applications	5
	6.1	Understanding features of NXP 89v51RD2, Atmega 328P and PIC16F886	
	6.2	Selecting a microcontroller for an application	
	6.3	Study of 89v51 based Clock Using I2C RTC and Seven Segment Display	
	6.4	PIC16F886 Speed Control of DC Motor.	
	6.5	Atmega 328P based remote temperature monitoring with LCD display	
Total			39

Text Books:

1. Douglas V Hall, SSSP Rao "Microprocessors & Interfacing", McGraw Hill
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw-Hill
3. Shibu K. V "Introduction to embedded systems" McGraw Hill.
4. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition 2006.
5. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010.
6. Steve Furber, "ARM System on chip Architecture", Pearson, 2nd edition.

Reference books:

1. "MCS@51 Microcontroller, Family User's Manual" Intel
2. "PIC16F882/883/884/886/887 Data Sheet", Microchip.
3. ATmega328P 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash datasheet, Atmel
4. P89V51RB2/RC2/RD2 8-bit 80C51 5 V low power 16/32/64 kB flash microcontroller, Data Sheet NXP founded by Philips
5. James A. Langbridge, "Professional Embedded Arm Development", Wrox, John Wiley Brand & Sons Inc., Edition 2014

NPTEL/ Swayam Course:

1. Course: Microprocessors and Microcontrollers By Prof. Santanu Chattopadhyay (IIT Kharagpur);
https://swayam.gov.in/nd1_noc20_ee42/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC403	Linear Integrated Circuits	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme								
		Theory Marks					Exam Duration (in Hrs)	Term Work	Prac. and Oral	Total
		Internal assessment			End Sem. Exam. (ESE)					
		Test1	Test2	Avg. of Test 1 and Test 2						
ECC403	Linear Integrated Circuits	20	20	20	80	03	--	--	100	

Course Pre-requisite:

1. FEC105-Basic Electrical Engineering
2. ECC302-Electronic Devices & Circuits

Course Objectives:

1. To understand the concepts, working principles and key applications of linear integrated circuits.
2. To perform analysis of circuits based on linear integrated circuits.
3. To design circuits and systems for particular applications using linear integrated circuits.

Course Outcome:

After successful completion of the course student will be able to:

1. Outline and classify all types of integrated circuits.
2. Understand the fundamentals and areas of applications for the integrated circuits.
3. Develop the ability to design practical circuits that perform the desired operations.
4. Understand the differences between theoretical & practical results in integrated circuits.
5. Identify the appropriate integrated circuit modules for designing engineering application.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Operational Amplifier	07
	1.1	Block diagram of Op-Amp. Ideal and practical characteristics of op-amp.	
	1.2	Configurations of Op-Amp: Open loop and closed loop configurations of Op-amp, Inverting and Non-inverting configuration of Op-amp and buffer.	
	1.3	Summing amplifier, difference amplifiers and Instrumentation amplifier using Op-amp.	
2.0		Linear Applications of Operational Amplifier	08
	2.1	Voltage to current and current to voltage converter.	
	2.2	Integrator & differentiator (ideal & practical), Active Filters: First and Second order active low pass, high pass, band pass, band reject and Notch filters.	
	2.3	Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.	
3.0		Non-Linear Applications of Operational Amplifier	07
3.0	3.1	Comparators: Inverting comparator, non-inverting comparator, zero crossing detectors, window detector.	
	3.2	Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger.	
	3.3	Waveform Generators: Square wave generator and triangular wave generator. Basics of Precision Rectifiers: Half wave and full wave precision rectifiers. Peak detector.	
4.0		Timer IC 555 and it's applications	07
	4.1	Functional block diagram and working of IC 555	
	4.2	Design of Astable and Monostable multivibrator using IC 555	
	4.3	Applications of Astable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator.	
5.0		Voltage Regulators.	06
	5.1	Functional block diagram, working and design of three terminal fixed voltage regulators (78XX, 79XX series).	
	5.2	Functional block diagram, working and design of general purpose IC 723 (HVLC and HVHC).	
	5.3	Introduction and block diagram of switching regulator, Introduction of LM 317.	
6.0		Special Purpose Integrated Circuits	04
	6.1	Functional block diagram and working of VCO IC 566 and application as frequency modulator.	
	6.2	Functional block diagram and working of PLL IC 565 and application as FSK Demodulator.	
		Total	39

Textbooks:

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall, 4th Edition.
2. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 4th Edition.

Reference Books:

1. K. R. Botkar, "Integrated Circuits", Khanna Publishers (2004)
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Tata McGraw Hill, 3rd Edition.
3. David A. Bell, "Operation Amplifiers and Linear Integrated Circuits", Oxford University Press, Indian Edition.
4. R. F. Coughlin and F. F. Driscoll, "Operation Amplifiers and Linear Integrated Circuits", Prentice Hall, 6th Edition.
5. J. Millman, Christos CHalkias, and Satyabratatajit, Millman's, "Electronic Devices and Circuits," McGrawHill, 3rd Edition.

NPTEL/ Swayam Course:

1. Course: ICs MOSFETs Op-Amps & Their Applications By Prof. Hardik Jeetendra Pandya (IISc Bangalore);
https://swayam.gov.in/nd1_noc20_ee13/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC404	Signals and Systems	03	--	01	03	--	01	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 & Test 2					
ECC404	Signals and Systems	20	20	20	80	03	25	--	125

Course pre-requisite:

1. ECC301 – Engineering Mathematics III

Course objectives:

1. To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.
2. To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.

Course outcomes:

After successful completion of the course student will be able to:

1. Classify and Analyze different types of signals and systems
2. Analyze continuous time LTI signals and systems in transform domain
3. Analyze and realize discrete time LTI signals and systems in transform domain
4. Represent signals using Fourier Series and Analyze the systems using the Fourier Transform.
5. Demonstrate the concepts learnt in Signals and systems Course using the modern engineering tools.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to signals and systems	07
	1.1	Introduction to Signals: Definition, Basic Elementary signals - exponential, sine, step, impulse, ramp, rectangular, triangular. Operations on signals. Classification of Signals: analog and discrete time signals, even and odd signals, periodic and non-periodic signals, deterministic and non-deterministic signals, energy and power signals.	
	1.2	Systems and Classification of systems: System Representation, continuous time and discrete systems, system with and without memory, causal and non-causal system, linear and nonlinear system, time invariant and time variant system, stable system.	
2.0		Time domain analysis of Continuous Time and Discrete Time systems	07
	2.1	Linear Time Invariant (LTI) systems: Representation of systems using differential /difference equation, Impulse, step and exponential response, System Stability and Causality.	
	2.2	Use of convolution integral and convolution sum for analysis of LTI systems, properties of convolution integral/sum, impulse response of interconnected systems.	
	2.3	Correlation and spectral Density: auto-correlation, cross correlation, analogy between correlation and convolution, energy spectral density, power spectral density, relation of ESD and PSD with auto-correlation.	
3.0		Fourier Analysis of Continuous and Discrete Time Signals and Systems	07
	3.1	Fourier transform of periodic and non-periodic functions, Properties of Fourier Transform, Inverse Fourier Transform, Frequency Response: computation of Magnitude and Phase Response, Limitations of Fourier Transform.	
4.0		Laplace Transform and Continuous time LTI systems	06
	4.1	Need of Laplace Transform, Concept of Region of Convergence, Properties of Laplace Transform, Relation between continuous time Fourier Transform and Laplace Transform, unilateral Laplace Transform, inverse Laplace Transform.	
	4.2	Analysis of continuous time LTI systems using Laplace Transform: Causality and stability of systems in s-domain, Total response of a system.	
5.0		z-Transform and Discrete time LTI systems	08
	5.1	Need of z-Transform, z-Transform of finite and infinite duration sequences, Concept of Region of Convergence, z-Transform	

		properties, Standard z-transform pairs, relation between z-transform and discrete time Fourier Transform, one sided z-Transform. Inverse z-Transform: Partial Fraction method only.	
	5.2	Analysis of discrete time LTI systems using z-Transform: Systems characterized by Linear constant coefficient difference equation, Transfer Function, plotting Poles and Zeros of a transfer function, causality and stability of systems, Total response of a system.	
6.0		FIR and IIR systems	04
	6.1	Concept of finite impulse response systems and infinite impulse response systems, Linear Phase FIR systems.	
	6.2	Realization structures of LTI system: Direct form –I and direct form II, Linear Phase FIR structures.	
Total			39

Text books:

1. Nagoor Kani, Signals and Systems, Tata McGraw Hill, Third Edition, 2011.
2. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, Signals and Systems, Pearson Education, Fourth Edition 2009.
3. Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, Second Edition, 2002.
4. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition, 2004.

Reference books:

- 1) Hwei. P Hsu, Signals and Systems, Tata McGraw Hill, Third edition, 2010
- 2) Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition, 2004.
- 3) V. Krishnaveni and A. Rajeshwari, Signals and Systems, Wiley-India, First Edition 2012.
- 4) Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, special Indian Economy edition, 2009.
- 5) Luis F. Chaparro, Signals and Systems Using MATLAB, Academic Press
- 6) Rangaraj M. Rangayyan, "Biomedical Signal Analysis- A Case Study Approach", Wiley 2002.
- 7) Signals and Systems Laboratory: Virtual Laboratory <http://ssl-iitg.vlabs.ac.in/>

NPTEL/ Swayam Course:

1. Course: Principles of Signals & Systems By Prof. Aditya K. Jagannatham (IIT Kanpur); https://swayam.gov.in/nd1_noc20_ee15/preview

Teachers and students are encouraged to use *Signals and Systems Laboratory: Virtual Laboratory* (Reference number 8) for demonstration of concepts such as systems and their properties, Fourier analysis etc.

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Term Work (25-Marks):

At least 06 Tutorials covering entire syllabus and 01 course project must be given during the "Class Wise Tutorial".

Students can form team of maximum 4 members and work on course project using any software viz. C, Python, Scilab, Matlab, Octave, etc. The course project should be appropriately selected in order to demonstrate any concept learnt in this course.

03-hours (out of the total 12-hours allotted for the tutorials) can be utilized for the course project completion.

Term work assessment must be based on the overall performance of the student with every tutorial and a course project graded from time to time. The grades will be converted to marks as per "Credit and Grading System" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC405	Principles of Communication Engineering	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme								
		Theory Marks					Exam Duration (in Hrs.)	Term Work	Prac. & Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test 2	Avg. of Test 1 and Test 2						
ECC405	Principles of Communication Engineering	20	20	20	80	03	--	--	100	

Course Pre-requisite:

1. ECC301 - Engineering Mathematics- III
2. ECC302 - Electronic Devices and Circuits

Course Objectives:

1. To illustrate the fundamentals of basic communication system.
2. To understand various analog modulation and demodulation techniques.
3. To focus on applications of analog modulation and demodulation techniques.
4. To explain the key concepts of analog and digital pulse modulation and demodulation techniques.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand the basic components and types of noises in communication system.
2. Analyze the concepts of amplitude modulation and demodulation.
3. Analyze the concepts of angle modulation and demodulation.
4. Compare the performance of AM and FM receivers.
5. Describe analog and digital pulse modulation techniques.
6. Illustrate the principles of multiplexing and demultiplexing techniques.

Module No.	Unit No.	Topics	Hours
1		Basics of Communication System	05
	1.1	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain. Basic concepts of wave propagation.	03
	1.2	Types of noise, signal to noise ratio, noise figure, noise temperature and Friss formula.	02
2		Amplitude Modulation and Demodulation	12
	2.1	Basic concepts, need for modulation, waveforms (time domain and frequency domain), modulation index, bandwidth, voltage distribution and power calculations.	04
	2.2	DSBFC: Principles, low-level and high-level transmitters, DSB suppressed carrier, Balanced modulators with diode (Ring modulator and FET) and SSB systems.	04
	2.3	Amplitude demodulation: Diode detector, practical diode detector, Comparison of different AM techniques, Applications of AM and use of VSB in broadcast television.	04
3		Angle Modulation and Demodulation	10
	3.1	Frequency and Phase modulation (FM and PM): Basic concepts, mathematical analysis, FM wave (time and frequency domain), sensitivity, phase and frequency deviation, modulation index, deviation ratio, bandwidth requirement of angle modulated waves, narrowband FM and wideband FM.	04
	3.2	Varactor diode modulator, FET reactance modulator, stabilized AFC, Direct FM transmitter, indirect FM Transmitter, noise triangle, pre- emphasis and de-emphasis	03
	3.3	FM demodulation: Balanced slope detector, Foster-Seely discriminator, Ratio detector, FM demodulator using Phase lock loop, amplitude limiting and thresholding, Applications of FM and PM.	03
4		Radio Receivers	04
	4.1	Characteristics of radio receivers, TRF, Super - heterodyne receiver block diagram, tracking and choice of IF, AGC and its types and Communication receiver.	03
	4.2	FM receiver block diagram, comparison with AM receiver.	01
5		Analog and Digital Pulse Modulation & Demodulation	06
	5.1	Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria, Sampling techniques, aliasing error and aperture effect.	03
	5.2	PAM, PWM, PPM generation, detection and applications. Basics of PCM system and differential PCM system. Concepts of Delta modulation (DM) and Adaptive Delta Modulation (ADM).	03
6		Multiplexing & De-multiplexing	02
	6.1	Frequency Division Multiplexing transmitter & receiver block diagram and applications. Time Division Multiplexing transmitter & receiver block diagram and applications.	02
		Total	39

Textbooks:

1. Kennedy and Davis, "Electronics Communication System", Tata McGraw Hill, Fourth edition.
2. B.P. Lathi, Zhi Ding "Modern Digital and Analog Communication system", Oxford University Press, Fourth edition.
3. Wayne Tomasi, "Electronics Communication Systems", Pearson education, Fifth edition.

Reference Books:

1. Taub, Schilling and Saha, "Taub's Principles of Communication systems", Tata McGraw Hill, Third edition.
2. P. Sing and S.D. Sapre, "Communication Systems: Analog and Digital", Tata McGraw Hill, Third edition.
3. Simon Haykin, Michel Moher, "Introduction to Analog and Digital Communication", Wiley, Second edition.
4. Dennis Roddy and John Coolen, Electronic Communication, Pearson, 4/e, 2011.
5. Louis Frenzel, "Communication Electronics", Tata McGraw Hill, Third Edition.

NPTEL/ Swayam Course:

1. Course: Analog Communication By Prof. Goutam Das (IIT Kharagpur);
https://swayam.gov.in/nd1_noc20_ee69/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-1). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL401	Micro-controllers Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL401	Micro-controllers Lab	-	-	-	-	-	25	--	25

Course Objectives:

1. To understand development tools of microcontroller based systems.
2. To learn programming for different microcontroller operation & interface to I/O devices.
3. To develop microcontroller based applications.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand different development tools required to develop microcontroller based systems.
2. Write assembly language programs for arithmetic and logical operations, code conversion & data transfer operations.
3. Write assembly language programs for general purpose I/O, Timers & Interrupts.
4. Interface & write programs for Input and Output devices
5. Develop microcontroller based Applications.

Suggested Experiment List:

1. Perform Arithmetic and Logical Operations (Using Immediate, Direct and Indirect addressing)
2. Code Conversion
3. Transfer of data bytes between Internal and External Memory
4. Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc
5. Interfacing of Matrix Key board, LED, 7 Segment display, LCD, Stepper Motor, UART

At Least 10 experiment Minimum two from each category of above list must be given during the **Laboratory session batch wise**. Computation/simulation based experiments are also encouraged.

Before starting the experiments there should be one session on Study of development tools like Editor, Assembler-cross Assembler, Compiler-Cross compiler, Linker, Simulator, emulator etc.

Mini project based on 8051 derivatives, PIC, AVR & other 8 bit microcontrollers using Assembly and/or C language. (Readymade of Arduino & raspberry pi are **not recommended here**)

Note: Mini Project can be considered as a part of term-work.

Term Work (25-Marks):

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL402	Linear Integrated Circuits Lab.	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam. Duration (in Hrs)	Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ECL402	Linear Integrated Circuits Lab.	--	--	--	--	--	25	25	50

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand the differences between theoretical, practical and simulated results in integrated circuits.
2. Apply the knowledge to do simple mathematical operations.
3. Apply knowledge of op-amp, timer and voltage regulator ICs to design simple applications.

Laboratory Plan:

Minimum 8 hardware practical (compulsorily based on IC 741, IC 555, IC 723 and remaining on VCO 566 or PLL 565) and 2 simulations should be conducted. At least one experiment from each Module of syllabus.

Suggested list of experiments:

1. Design inverting, non-inverting amplifier and buffer using IC 741.
2. Design summing and difference amplifier using op-amp.
3. Design voltage to current converter with grounded load.
4. Design and analyze Integrator
5. Design and analyze Differentiator
6. Design Schmitt trigger using Op-amp.
7. Design Wein bridge and RC phase shift Oscillator.
8. Design and analyze second order High pass and Low pass filter
9. Design and analyze Band pass and Band reject filter.
10. Design Astable multivibrator using IC 555 for fixed frequency and variable duty cycle.
11. Design Monostable Multivibrator using IC 555.
12. Design Low voltage Low current voltage regulator using IC 723.
13. Design High voltage High current voltage regulator using IC 723.
14. Design Frequency Modulator using IC 566
15. Design FSK Demodulator using IC 565
16. Design Instrumentation amplifier using 3 Op-Amp.
17. Design Precision rectifier
18. Design Square & Triangular wave generator

Term Work (25-Marks):

At least 10 Experiments including 02 simulations covering entire syllabus must be given during the "Laboratory session batch wise". Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time.

The practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL403	Principles of Communication Engineering Lab.	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL403	Principles of Communication Engineering Lab.	--	--	--	--	--	25	25	50

Course Pre-requisites:

1. Usage of basic Electronic instruments and components.
2. Fundamentals of Electronic Devices and circuits

Course Objectives:

1. To give an understanding of Time and Frequency domain representation of signals.
2. To demonstrate continuous wave modulation and demodulation.
3. To demonstrate analog and digital pulse communication.
4. Able to use simulation software to build communication circuits.

Course Outcomes:

After successful performance of the practicals student will be able to:

1. Analyze analog modulation techniques.
2. Analyze the waveforms of Radio receivers.
3. Implement analog pulse modulation and demodulation circuits.
4. Demonstrate digital pulse modulation and demodulation techniques.
5. Verify the concepts of TDM and FDM.

Suggested list of Experiments:

Sr. No	Title
1	Generation of AM modulation and demodulation.
2	Analyze waveforms at various stages of SSB system.
3	Generation of FM modulation and demodulation.
4	Analyze the output waveforms of each block of AM transmitter /receiver
5	Analyze the output waveforms of each block of FM transmitter /receiver
6	Design and implement Pre-emphasis and De-emphasis circuit.
7	Verification of sampling theorem.
8	Generation of PAM modulation and demodulation.
9	Generation of PWM and PPM modulation and demodulation.
10	Demonstrate Digital pulse transmission technique (PCM)
11	Demonstrate Digital pulse transmission technique (DM,ADM)
12	Observation of TDM multiplexing and de-multiplexing signals.
13	Observation of FDM multiplexing and de-multiplexing signals.

Term Work (25-Marks):

At least **10** experiments (**07 hardware experiments and at least 03 software experiments**) covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and application oriented. Signal should be analyzed in time and frequency domain.

Term work assessment must be based on the overall performance of the student with every Experiments are graded from time to time.

The grades will be converted to marks as per "**Credit and Grading System**" manual and should be added and averaged. Based on the above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encouraged to share their experiments codes on online repository. Practical exam slip should cover all 10 experiments for examination.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL404	Skill Lab: Python Programming	-	04	--	--	02	--	02

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Practical and Oral	Total
		Internal assessment			Avg. of Test 1 and Test 2				
		Test 1	Test 2						
ECL404	Skill Lab: Python Programming	-	-	-	-	-	25	25	50

NOTE: Necessary theory part should be taught by the teacher at the beginning of the laboratory session.

Course pre-requisite:

1. ECL304 – Skill Lab: C++ and Java Programming.

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Explore file handling in Python
3. Infer the Object-oriented Programming concepts in Python
4. Formulate GUI Programming and Databases operations in Python
5. Develop applications using variety of libraries and functions

Course Outcomes:

After successful completion of the course student will be able to:

1. Describe syntax and semantics in Python
2. Illustrate different file handling operations
3. Interpret object oriented programming in Python
4. Design GUI Applications in Python
5. Express proficiency in the handling Python libraries for data science
6. Develop machine learning applications using Python

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Python	6
	1.1	Introduction to Python, Installation and resources, Identifiers and Keywords, Comments, Indentation and Multi-lining, Variables (Local and Global), data types, Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats, Input Statements in python	
	1.2	Strings, Lists, Tuples, Dictionaries, Sets, Accessing Elements, Properties, Operations and methods on these data structures.	
	1.3	Decision Flow Control Statement: if and else statement, Nested If statement, Loop Statement: While Loop, do and while loop, for loop statement, Continue, Break and pass Statement, Conditional Statements	
2.0		Functions and File I/O Handling	8
	2.1	Functions: Built-in-functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions, Modules and importing packages in python code.	
	2.2	File Input/Output: Files I/O operations, Read / Write Operations, File Opening Modes, <i>with</i> keywords, Moving within a file, Manipulating files and directories, OS and SYS modules.	
3.0		Object Oriented Programming	9
	3.1	Classes and Objects, Public and Private Members, Class Declaration and Object Creation, Object Initialization, Class Variables and methods, Accessing Object and Class Attributes.	
	3.2	Intricacies of Classes and Objects, Inheritance, Constructor in Inheritance, Exception Handling, Link list, Stack, Queues.	
4.0		Graphical User Interface and Image processing	9
	4.1	Graphical User Interface using Tkinter Library module, creating simple GUI; Buttons, Labels, entry fields, widget attributes.	
	4.2	Database: Sqlite database connection, Create, Append, update, delete records from database using GUI.	
	4.3	Basic Image Processing using OpenCV library, simple image manipulation using image module.	
5.0		Numpy, Pandas, Matplotlib, Seaborn, Scipy	10
	5.1	Introduction to Numpy, Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy.	
	5.2	Introduction to Pandas, Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and write operation.	
	5.3	Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn.	
	5.4	Introduction to Scipy, Scipy Sub packages – Integration and Optimization, Eigen values and Eigen Vectors, Statistic, Weave and IO.	
6.0		Python Applications	10
	6.1	GUI based applications	
	6.2	Applications in Image Processing, Networking	
	6.3	Machine Learning, Linear Regression, Logistic Regression	
	6.4	Classification using K nearest neighbor,	
	6.5	Support Vector Machines	
Total			52

Text Books:

1. Yashavant Kanetkar, "Let us Python: Python is Future, Embrace it fast", BPB Publications; 1 edition (8 July 2019).
2. Dusty Phillips, "Python 3 object-oriented Programming", Second Edition PACKT Publisher August 2015.
3. John Grayson, "Python and Tkinter Programming", Manning Publications (1 March 1999).
4. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
6. Introduction to computing and problem solving using python , E Balagurusamy, McGraw Hill Education.
7. Zed A. Shaw, "Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code", Addison Wesley; 3 edition (1 October 2013).

Reference Books:

1. Eric Matthes, "Python Crash Course A hands-on, Project Based Introduction to programming" No Starch Press; 1 edition (8 December 2015).
2. Paul Barry, "Head First Python" O'Reilly; 2 edition (16 December 2016)
3. Andreas C. Mueller, "Introduction to Machine Learning with Python", O'Reilly; 1 edition (7 October 2016)
4. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3", O'Reilly Media; 3 edition (10 May 2013).
5. Bhaskar Chaudhary, "Tkinter GUI Application Development Blueprints: Master GUI programming in Tkinter as you design, implement, and deliver 10 real world application", Packt Publishing (November 30, 2015)

Software Tools:

1. Python IDE: <https://www.python.org/downloads/>
2. Anaconda Environment: <https://www.anaconda.com/distribution/>

Online Repository:

1. Github
2. Python 3 Documentation: <https://docs.python.org/3/>
3. "The Python Tutorial", <http://docs.python.org/release/3.0.1/tutorial/>
4. <http://spoken-tutorial.org>
5. Python 3 Tkinter library Documentation: <https://docs.python.org/3/library/tk.html>
6. Numpy Documentation: <https://numpy.org/doc/>
7. Pandas Documentation: <https://pandas.pydata.org/docs/>
8. Matplotlib Documentation: <https://matplotlib.org/3.2.1/contents.html>
9. Scipy Documentation : <https://www.scipy.org/docs.html>
10. Machine Learning Algorithm Documentation: <https://scikit-learn.org/stable/>
11. <https://nptel.ac.in/courses/106/106/106106182/>

The following list of experiments and course project is for illustration purpose. Faculty members are required to introduce their own innovative list of experiments based on above curriculum.

Sr. No.	Problem Statement	Module No.
1.	1. Write python programs to understand expressions, variables, quotes, basic math operations, list, tuples, dictionaries, arrays etc. 2. Write Python program to implement byte array, range, set and different STRING Functions (len, count, lower, sorted etc) 3. Write Python program to implement control structures.	Module 1

	<p>4. Assume a suitable value for distance between two cities (in km). Write a program to convert and print this distance in meters, feet, inches and centimetre.</p> <p>5. Write a program to carry out the following operations on the given set</p> <p style="padding-left: 40px;">$s = \{10, 2, -3, 4, 5, 88\}$</p> <ol style="list-style-type: none"> a. Number of items in sets s b. Maximum element in sets s c. Minimum element in sets s d. Sum of all elements in sets s e. Obtain a new sorted set from s, set s remaining unchanged f. Report whether 100 is an element of sets s g. Report whether -3 is not an element of sets s. 	
2.	<ol style="list-style-type: none"> 1. Write python program to understand different File handling operations 2. Create 3 lists – a list of names, a list of ages and a list of salaries. Generate and print a list of tuples containing name, age and salary from the 3lists. From this list generate 3 tuples – one containing all names, another containing all ages and third containing all salaries. 	Module 2
3.	<ol style="list-style-type: none"> 1. Write Python program to implement classes, object, Static method and inner class 2. If any integer is given as in input through the keyboard, write a program to find whether it is odd or even number. 3. If ages of Ram, Shyam, and Ajay are given as an input through the keyboard, write a program to determine the youngest of the three. 4. Write a program that prints square root and cube root of numbers from 1 to 10, up to 4 decimal places. Ensure that the output is displayed in separate lines, with number center-justified and square and cube roots right-justified. 5. Write a program to find the factorial value of any number entered through the keyboard. 6. Write a program that defines a function count_lower_upper() that accepts a string and calculates the number of uppercase and lowercase alphabets in it. It should return these values as a dictionary. Call this function for some sample strings. 7. A 5-digit positive integer is entered through the keyboard, write a recursive function to calculate sum of digits of 5-digit number. 	Module 3
4.	<ol style="list-style-type: none"> 1. Write Python program to create, append, update, delete records from database using GUI. 2. Write Python program to obtain histogram of any image 3. Write Python Program to split color image in R,G,B and obtain individual histograms. 4. Write Python program for histogram equalization 5. Write Python Program for edge detection 6. Write Python Program for image segmentation 7. Write Python program to implement GUI Canvas application using Tkinter 8. Write Python program to implement GUI Frame application using Tkinter 	Module 4
5.	<ol style="list-style-type: none"> 1. Write Python program to study define, edit arrays and perform arithmetic operations. 2. Write python program to study selection, indexing, merging, joining, concatenation in data frames 3. Evaluate the dataset containing the GDPs of different countries to: <ol style="list-style-type: none"> a. Find and print the name of the country with the highest GDP b. Find and print the name of the country with the lowest GDP c. Print text and input values iteratively 	Module 5

	<p>d. Print the entire list of the countries with their GDPs</p> <p>e. Print the highest GDP value, lowest GDP value, mean GDP value, standardized GDP value, and the sum of all the GDPs</p> <p>4. Analyze the Federal Aviation Authority (FAA) dataset using Pandas to do the following:</p> <ol style="list-style-type: none"> a. View: aircraft make name, state name, aircraft model name, text information, flight phase, event description type, b. fatal flag c. b. Clean the dataset and replace the fatal flag NaN with “No”. d. c. Find the aircraft types and their occurrences in the dataset e. d. Remove all the observations where aircraft names are not available f. Display the observations where fatal flag is “Yes” <p>5. Analyze the “auto mpg data” and draw a pair plot using seaborn library for mpg, weight, and origin.</p> <p>(a) Origin: This dataset was taken from the StatLib library maintained at Carnegie Mellon University.</p> <ul style="list-style-type: none"> • Number of Instances: 398 • Number of Attributes: 9 including the class attribute • Attribute Information: • mpg: continuous • cylinders: multi-valued discrete • displacement: continuous • horsepower: continuous • weight: continuous • acceleration: continuous • model year: multi-valued discrete • origin: multi-valued discrete • car name: string (unique for each instance) <p>5. Write python program to use SciPy to solve a linear algebra problem.</p> <p>6. There is a test with 30 questions worth 150 marks. The test has two types of questions: 1. True or false – carries 4 marks each 2. Multiple-choice – carries 9 marks each. Find the number of true or false and multiple-choice questions.</p>	
6.	<ol style="list-style-type: none"> 1. Write python program to study linear regression 2. Write python program to study multiple linear regression 3. Write python program to study logistic regression 4. Write python program to study Support Vector Machine 5. Write python program to study decision tree algorithm 6. Write python program to study two-way communication between client and server. 7. Write Python Program to study image morphological operations. 	Module 6

Suggested list of course projects:

- Speed typing Test using Python
- Music player in Python
- Calculator app using tkinter
- Train announcement system using python
- Dice rolling simulator
- Expense tracker
- Contact book using python
- Develop classification model using freely available datasets
- Develop python application for sentiment analysis

Note:

1. Use of free cloud service such as Google Colab to run python scripts is encouraged.
2. Necessary theory part should be taught by the teacher at the beginning of the laboratory session.

Term Work (25-Marks):

At least **12 experiments and 01 course project** should be performed. Term work assessment must be based on the overall performance of the student with every experiment and project graded from time-to-time. The grades will be converted to marks as per “**Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM401	Mini Project 1B	--	04 ^{\$}	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. Of Test1 and Test2				
ECM401	Mini Project 1B	--	--	--	--	25	25	50

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

Objectives

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.

Outcome: At the end of the course learners 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. Analyse 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 life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- 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.
- 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.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- 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.
- 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.

Guidelines for Assessment of Mini Project:

Term Work

- 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.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- 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.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- 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.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project 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 **one year, project**, 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 **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- 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 organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project 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

NOTE: For Electronics & Telecommunication Engineering we recommend following syllabus for Mini-Project 1B, in case it is half-year project.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM401	Mini-Project 1B: Arduino & Raspberry Pi based Projects	-	04 ^{\$}	--	--	02	--	02

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Practical and Oral	Total
		Internal assessment			Avg. Of Test 1 and Test 2				
		Test 1	Test 2						
ECM401	Mini-Project 1B: Arduino & Raspberry Pi based Projects	-	-	-	-	25	25	50	

\$ indicates work load of Learner (Not Faculty), for Mini Project 1B. Faculty Load: 1 hour per week per four groups.

Course pre-requisite:

1. ECM301 – Mini-Project 1A
2. ECL304 – C++ and Java Programming
3. ECC302 – Electronic Devices and Circuit

Course Objectives:

1. To make students familiar with the basics of Electronics, Microcontroller, Arduino board, Raspberry Pi, Arduino IDE (Integrated Development Environment) and Python programming.
2. To familiarize the students with the programming and interfacing of different devices with Arduino and Raspberry Pi Board.
3. To increase students critical thinking ability and provide solutions to some real time problems.

Course Outcomes:

After successful completion of the course student will be able to

1. Write basic codes for the Arduino board using the IDE for utilizing the onboard resources.
2. Apply the knowledge of interfacing different devices to the Arduino board to accomplish a given task.
3. Design Arduino based projects for a given problem.
4. Write code using python language using IDE for utilizing the onboard resources.
5. Apply the knowledge of interfacing different devices to raspberry Pi board to accomplish a given task.
6. Design Raspberry Pi based projects for a given problem.

Experiment No.	Unit No.	Section A: Arduino Board	Hrs.
EX.1.0		Introduction to Arduino Board	02
	1.1	Introduction to Arduino Uno board and integrated development environment (IDE	
	1	Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software.	
EX.2.0		GPIO (along with Analog pin) Programming	04
	2.1	Introduction to programming GPIO, Analog and PWM PINS.	
	1	Interface any Digital Sensors to the Arduino board and display sensor values on serial Monitor.	
	2	Interface any Analog sensor to the Arduino board and display sensor values on serial Monitor.	
	3.	Generate varying duty cycle PWM using Arduino.	
EX.3.0		Controlling output devices/Displaying	04
	3.1	Introduction to different sensor (Analog and Digital), Relays, Motors and display.	
	1	Interface an Analog Sensors to the Arduino board and display sensor values on LCD/TFT/Seven segment Display.	
	2	Interface a temperature sensor to Arduino and switch on a relay to operate a fan if temperature exceeds given threshold. Also display the temperature on any of the display device	
EX.4.0		Interfacing Communication Devices and Cloud Networking	04
	4.1	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.	
	1	Interface Wi-Fi /Bluetooth/GSM/Zigbee/RF module to Arduino and program it to transfer sensor data wirelessly between two devices. Any two techniques from the above-mentioned modules needs to be interfaced.	
5.0		Sample Projects	10
	1.	Waste Management System	
	2.	Smart City Solutions	
	3.	Energy Monitoring Systems	
	4.	Smart Classrooms and learning Solutions	
	5.	Home security systems	
	6.	Smart Agriculture solutions	
	7.	Healthcare solutions.	
	8.	Industrial Applications	
	9.	IoT Applications	
	10.	Robotics	
Section 'A' Total Hrs.			24

Experiment No.	Unit No.	Section B: Raspberry Pi	Hrs.
EX.1.0		Introduction to Raspberry PI	02
	1.1	What is Raspberry PI? Downloading and Installation of NOOBS, First Power-Up & Having a Look around, Introduction to the Shell and Staying updated.	
	1	Familiarization with Raspberry PI and perform necessary software installation. Apparatus Requirement: Hardware: Raspberry PI Board, Memory of 16GB, Power adapter, Memory Writer. Software: NOOBS, Raspbian OS, Win32 disk Imager, SD-Formatter software.	

EX.2.0		Interfacing with Input / Output Devices using Python	04
	2.1	Introduction to Python, Connecting to the outside World with GPIO.	
	1	To Interface LED/Buzzer with Raspberry PI and write a program to turn ON LED for 1 sec after every 2 sec. Apparatus Requirement: Raspberry PI with inbuilt Python Package, LED, Buzzer.	
	2	To interface Push Button / Digital Sensor (IR/LDR) with Raspberry PI and write a program to turn ON LED when Push button is pressed or at sensor detection. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Push Button Switch, Digital Sensor (IR/LDR).	
	3.	To interface analog sensor using MCP 3008 analog to digital converter chip. Apparatus Requirement: Raspberry PI with inbuilt Python Package, analog sensor, MCP 3008 chip.	
EX.3.0		Interfacing Temperature Sensor, Motors, Display Devices.	04
	3.1	Introduction to Temperature sensor (Analog and Digital), Relays, Motors (DC, Stepper) and Driver circuits.	
	1	To interface DHT11 sensor with Raspberry PI and write a program to print temperature and humidity readings. Apparatus Requirement: Raspberry PI with inbuilt Python Package, DTH11 Sensor.	
	2	To interface motor using relay with Raspberry PI and write a program to turn ON motor when push button is pressed. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Relays, Motor Driver, Motors.	
	3	To interface OLED with Raspberry PI and write a program to print temperature and humidity readings on it. Apparatus Requirement: Raspberry PI with inbuilt Python Package, OLED display device.	
EX.4.0		Interfacing Communication Devices and Cloud Networking	04
	4.1	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.	
	1	To interface Bluetooth/Zigbee/RFID/WiFi with Raspberry PI and write a program to send sensor data to smartphone using Bluetooth/Zigbee/RFID/WIFI. (Any one can be used for performing) Apparatus Requirement: Raspberry PI with inbuilt Python Package, Bluetooth/Zigbee/RFID/WIFI.	
	2	Introduction to Cloud computing, different types cloud networks and interconnection using Raspberry PI	
	3	Write a program on Raspberry PI to upload temperature and humidity data from thingspeak cloud. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Cloud networks such as thingspeak (open source), AWS, Azure, etc. anyone can be used for understanding purpose and building projects.	
EX.5.0		Understanding of Communication Protocols	04
	5.1	Introduction to MQTT, IFTTT protocols and configuration steps.	
	1	Write a program on Raspberry PI to publish temperature data to MQTT broker	
	2	Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it.	
	3	Configuration of Webserver using Raspberry PI.	
6.0		Sample Projects	10
	1.	MQTT Based Raspberry Pi Home Automation: Controlling Raspberry Pi GPIO using MQTT Cloud	
	2.	License Plate Recognition using Raspberry Pi and OpenCV	
	3.	Real Time Face Recognition with Raspberry Pi and OpenCV	
	4.	Smart Garage Door Opener using Raspberry Pi	

5.	Remote Controlled Car Using Raspberry Pi and Bluetooth	
6.	Fingerprint Sensor based door locking system using Raspberry Pi	
7.	Raspberry Pi Ball Tracking Robot using Processing	
8.	Web Controlled Home Automation using Raspberry Pi	
9.	Line Follower Robot using Raspberry Pi	
10.	Raspberry Pi based Smart Phone Controlled Home Automation	
11.	Web Controlled Raspberry Pi Surveillance Robotic Car	
12.	Raspberry Pi Based Weight Sensing Automatic Gate	
13.	Raspberry Pi Emergency Light with Darkness and AC Power Line Off Detector	
14.	Detecting Colors using Raspberry Pi and Color Sensor TCS3200	
15.	Measure Distance using Raspberry Pi and HCSR04 Ultrasonic Sensor	
16.	Call and Text using Raspberry Pi and GSM Module	
17.	Raspberry Pi Home Security System with Email Alert	
18.	Raspberry Pi Based Obstacle Avoiding Robot using Ultrasonic Sensor	
19.	Web Controlled Notice Board using Raspberry Pi	
20.	RF Remote Controlled LEDs Using Raspberry Pi	
21.	RFID and Raspberry Pi Based Attendance System	
22.	Raspberry Pi Interactive Led-Mirror	
23.	Garage Door monitor using Raspberry Pi	
24.	Raspberry Pi Digital Code Lock on Breadboard	
25.	Electronic Voting Machine using Raspberry Pi	
Section 'B' Total Hrs.		28
Total A + B		52

Reference Books:

1. Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education TAB; 2 edition (September 28, 2017)
2. Simon Monk, "Raspberry Pi Cookbook Software and Hardware Problems and Solutions" O'Reilly 2nd Edition
3. Simon Monk, Programming the Raspberry Pi, 2nd Edition: Getting Started with Python" The McGraw Hill
4. "DK Workbooks: Raspberry Pi Project Workbook", DK Children; Workbook edition (March 7, 2017)
5. Donald Norris, "Raspberry Pi Electronic Projects for Evil Genius", McGraw-Hill Education TAB; 1 edition (May 20, 2016)

Software Tools:

1. Raspbian OS: <https://www.raspberrypi.org/downloads/>
2. Win32 Disk Imager: <https://sourceforge.net/projects/win32diskimager/>
3. SD Card Formatter: <https://www.sdcard.org/downloads/formatter/>
4. Arduino IDE: <https://www.arduino.cc/en/main/software>

Online Repository:

1. GitHub
2. NPTEL Videos on Raspberry Pi and Arduino Programming
3. <https://www.electronicsforu.com/raspberry-pi-projects>
4. <https://circuitdigest.com/simple-raspberry-pi-projects-for-beginners>
5. <https://www.electronicshub.org/raspberry-pi-projects/>

6. Spoken Tutorial Project-IIT Bombay: https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English
7. Teachers are recommended to use a free online simulation platform “Tinkercad” for the simulation of Arduino based circuits before the students implement it in the hardware: <https://www.tinkercad.com/>

University of Mumbai



No. UG/ 49 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to the syllabus directly uploaded by the Academic Authority Unit which was accepted by the Academic Council at its meeting held on 11th May, 2017 vide item No.4.180 relating to the revised syllabus as per the (CBCGS) for Bachelor of Engineering (Information Technology) Second Year w.e.f. AY 2017-18, Third Year w.e.f. AY 2018-19 and Final Year w.e.f. AY 2019-20 (Rev – 2016) from Academic Year 2016-17.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Information Technology at its meeting held on 24th April, 2020 and subsequently made by the Board of Deans at its meeting held on 26th June, 2020 vide item No. 14(10) have been accepted by the Academic Council at its meeting held on 23rd July, 2020 vide item No. 4.126 and that in accordance therewith, the Scheme (Sem. III to VIII) and revised syllabus (Rev-2019 'C' Scheme) for the B.E. in Information Technology (Sem.III & IV) has been brought into force with effect from the academic year 2020-21. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

21st January, 2021

To

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

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

A.C/4.126/23/07/2020

No. UG/ 49 -A of 2021

MUMBAI-400 032

21st January, 2021

Copy forwarded with Compliments for information to:-

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

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

Copy to :-

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

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

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

for information.

AC: 23/7/2020

Item No. 4126

UNIVERSITY OF MUMBAI**Syllabus for Approval**

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

Date :23/7/2020

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

Attyajindas
Dr. Anusachha Majumdar
Dr. Anusachha Majumdar
Dean
Faculty of Science and Technology
University of Mumbai

AC: 23/7/2020

Item No. : 126

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)

AC: 23/7/2020

Item No. 126

UNIVERSITY OF MUMBAI



Syllabus for Approval

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

Date: 23/7/2020

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 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
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University of Mumbai

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

Preface By BoS

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.

Board of Studies in Information Technology Engineering - Team

Dr. Deven Shah (Chairman)
Dr. Lata Ragma (Member)
Dr. Vaishali D. Khairnar (Member)
Dr. Sharvari Govilkar (Member)
Dr. Sunil B. Wankhade (Member)
Dr. Anil Kale (Member)
Dr. Vaibhav Narwade (Member)
Dr. GV Choudhary (Member)
Ad-hoc Board Information Technology
University of Mumbai

**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 Front end /backend Application using JAVA	--	4 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	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 Front end /backend Application using JAVA	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	125	775

\$ 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 Python based automation projects	--	4 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	7	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
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 Python based automation projects	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	75	775

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

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		
ITC501	Internet Programming	3	--		3	--	3		
ITC502	Computer Network Security	3	--		3	--	3		
ITC503	Entrepreneurship and E- business	3	--		3	--	3		
ITC504	Software Engineering	3	--		3	--	3		
ITDO501X	Department Optional Course – 1	3	--		3	--	3		
ITL501	IP Lab	-	2		--	1	1		
ITL502	Security Lab	-	2		--	1	1		
ITL503	DevOPs Lab	-	2		--	1	1		
ITL504	Advance DevOPs Lab	-	2		--	1	1		
ITL505	Business Communication and Ethics	-	2*+2		--	2	2		
ITM501	Mini Project – 2 A Web Based Business Model	-	4 ^s		--	2	2		
Total		15	16		15	08	23		
Course Code	Course Name	Examination Scheme							
		Theor y					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
ITC501	Internet Programming	20	20	20	80	3	--	--	100
ITC502	Computer Network Security	20	20	20	80	3	--	--	100
ITC503	Entrepreneurship and E- business	20	20	20	80	3	--	--	100
ITC504	Software Engineering	20	20	20	80	3	--	--	100
ITDO501X	Department Optional Course – 1	20	20	20	80	3	--	--	100
ITL501	IP Lab	--	--	--	--	--	25	25	50
ITL502	Security Lab	--	--	--	--	--	25	25	50
ITL503	DevOPs Lab	--	--	--	--	--	25	25	50
ITL504	Advance DevOPs Lab	--	--	--	--	--	25	25	50
ITL505	Business Communication and Ethics	--	--	--	--	--	50	--	50

ITM501	Mini Project – 2 A Web Based Business Model	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	175	125	800

* Theory class to be conducted for full class

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

ITDO501X	Department Optional Course – 1
ITDO5011	Microcontroller Embedded Programming
ITDO5012	Advance Data Management Technologies
ITDO5013	Computer Graphics & Multimedia System
ITDO5014	Advanced Data structure and Analysis

Program Structure for Third Year Engineering
Semester V & VI
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		
ITC601	Data Mining & Business Intelligence	3	--		3	--	3		
ITC602	Web X.0	3	--		3		3		
ITC603	Wireless Technology	3	--		3	--	3		
ITC604	AI and DS – 1	3	--		3	--	3		
ITDO601 X	Department Optional Course – 2	3	--		3	--	3		
ITL601	BI Lab	--	2		--	1	1		
ITL602	Web Lab	--	2		--	1	1		
ITL603	Sensor Lab	--	2		--	1	1		
ITL604	MAD & PWA Lab	--	2		--	1	1		
ITL605	DS using Python Skill based Lab	--	2		--	1	1		
ITM601	Mini Project – 2 B Based on ML	--	4 ^s		--	2	2		
Total		15	14		15	07	22		
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
ITC601	Data Mining & Business Intelligence	20	20	20	80	3	--	--	100
ITC602	Web X.0	20	20	20	80	3	--	--	100
ITC603	Wireless Technology	20	20	20	80	3	--	--	100
ITC604	AI and DS – 1	20	20	20	80	3	--	--	100
ITDO601 X	Department Optional Course – 2	20	20	20	80	3	--	--	100
ITL601	BI Lab	--	--	--	--	--	25	25	50
ITL602	Web Lab	--	--	--	--	--	25	25	50
ITL603	Sensor Lab	--	--	--	--	--	25	25	50
ITL604	MAD & PWA Lab	--	--	--	--	--	25	25	50
ITL605	DS using Python Lab (SBL)	--	--	--	--	--	25	25	50

ITM601	Mini Project – 2 B Based on ML	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	150	800

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

ITDO601X	Department Optional Course – 2
ITDO6011	Software Architecture
ITDO6012	Image Processing
ITDO6013	Green IT
ITDO6014	Ethical Hacking and Forensic

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

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract. Tut.	Theory	Pract.	Total			
ITC701	AI and DS –II	3	--	3	--	3			
ITC702	Internet of Everything	3	--	3		3			
ITDO701 X	Department Optional Course – 3	3	--	3	--	3			
ITDO702 X	Department Optional Course – 4	3	--	3	--	3			
ITIO701X	Institute Optional Course – 1	3	--	3	--	3			
ITL701	Data Science Lab	--	2	--	1	1			
ITL702	IOE Lab	--	2	--	1	1			
ITL703	Secure Application Development	--	2	--	1	1			
ITL704	Recent Open Source Project Lab	--	2	--	1	1			
ITP701	Major Project I	--	6 [#]	--	3	3			
Total		15	14	15	7	22			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
ITC701	AI and DS –II	20	20	20	80	3	--	--	100
ITC702	Internet of Everything	20	20	20	80	3	--	--	100
ITDO701 X	Department Optional Course – 3	20	20	20	80	3	--	--	100
ITDO702 X	Department Optional Course – 4	20	20	20	80	3	--	--	100
ITIO701X	Institute Optional Course – 1	20	20	20	80	3	--	--	100
ITL701	Data Science Lab	--	--	--	--	--	25	25	50
ITL702	IOE Lab	--	--	--	--	--	25	25	50
ITL703	Secure Application Development	--	--	--	--	--	25	25	50
ITL704	Recent Open Source Project Lab	--	--	--	--	--	25	25	50
ITP701	Major Project I	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	125	125	750

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

ITDO701X	Department Optional Course –3
ITDO7011	Storage Area Network
ITDO7012	High Performance computing
ITDO7013	Infrastructure Security
ITDO7014	Software Testing and QA

ITDO702X	Department Optional Course –4
ITDO7021	MANET
ITDO7022	AR – VR
ITDO7023	Quantum Computing
ITDO7024	Information Retrieval System

ITIO701X	Institute Optional Course – 1 (Common for all branches will be notified)
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**Program Structure for Fourth Year Engineering
Semester VII & VIII
UNIVERSITY OF MUMBAI
(With Effect from 2022-2023)**

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract. Tut.	Theory	Pract.	Total			
ITC801	Blockchain and DLT	3	--	3	--	3			
ITDO801 X	Department Optional Course – 5	3	--	3	--	3			
ITDO802 X	Department Optional Course – 6	3	--	3	--	3			
ITIO801X	Institute Optional Course – 2	3	--	3	--	3			
ITL801	Blockchain Lab	--	2	--	1	1			
ITL802	Cloud computing	--	2	--	1	1			
ITP801	Major Project II	--	12 [#]	--	6	6			
Total		12	16	12	8	20			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
ITC801	Blockchain and DLT	20	20	20	80	3	--	--	100
ITDO801 X	Department Optional Course – 5	20	20	20	80	3	--	--	100
ITDO802 X	Department Optional Course – 6	20	20	20	80	3	--	--	100
ITIO801X	Institute Optional Course – 2	20	20	20	80	3	--	--	100
ITL801	Blockchain Lab	--	--	--	--	--	25	25	50
ITL802	Cloud computing	--	--	--	--	--	25	25	50
ITP801	Major Project II	--	--	--	--	--	100	50	150
Total		--	--	80	320	--	150	100	650

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

Students group and load of faculty per week.

Mini Project 1 and 2 :

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

Faculty Load : 1 hour per week per four groups

Major Project 1 and 2 :

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

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

In Semester VIII – 1 hour per week per project group

ITDO801X	Department Optional Course – 5
ITDO8011	Big Data Analytics
ITDO8012	Reinforcement learning
ITDO8013	Simulation and Modeling
ITDO8014	Knowledge management

ITDO802X	Department Optional Course –6
ITDO8021	User Interface Design
ITDO8022	Robotics
ITDO8023	ERP
ITDO8024	Cloud computing and Services

ITIO801X	Institute Optional Course – 2 (Common for all branches will be notified)
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AC: 23/7/2020

Item No. : 126

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)

AC: 23/7/2020

Item No. 126

UNIVERSITY OF MUMBAI



Syllabus for Approval

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

Date :23/7/2020

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 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 BoS

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.

Board of Studies in Information Technology Engineering - Team

Dr. Deven Shah (Chairman)
Dr. Lata Ragma (Member)
Dr. Vaishali D. Khairnar (Member)
Dr. Sharvari Govilkar (Member)
Dr. Sunil B. Wankhade (Member)
Dr. Anil Kale (Member)
Dr. Vaibhav Narwade (Member)
Dr. GV Choudhary (Member)
Ad-hoc Board Information Technology
University of Mumbai

**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 ^s	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	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
Total		--	--	100	400	--	150	125	775

\$ indicates work load of Learner (Not Faculty), for Mini-Project. 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
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 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	7	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
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
Total		--	--	100	400	--	150	75	775

\$ indicates work load of Learner (Not Faculty), for Mini Project. 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	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme								
		Theory				End Sem Exam	Term Work	Pract	Oral	Total
		Internal Assessment		Avg of Test 1 & 2						
Test1	Test2									
ITC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125	

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

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2	To acquaint with the concept of Fourier series, its complex form and enhance the problem solving skills.
3	To familiarize the concept of complex variables, C-R equations with applications.
4	The fundamental knowledge of Trees, Graphs etc.
5	To study the basic techniques of statistics like correlation, regression and curve fitting for data analysis, Machine learning and AI.
6	To understand some advanced topics of probability, random variables with their distributions and expectations.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apply the concept of Laplace transform to solve the real integrals in engineering problems.	L1, L2
2	Apply the concept of inverse Laplace transform of various functions in engineering problems.	L1, L2

3	Expand the periodic function by using Fourier series for real life problems and complex engineering problems.	L1, L2, L3
4	Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.	L1, L2, L3
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning and AI.	L2, L3
6	Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.	L1, L2

Module	Detailed Contents	Hours	CO Mapping
01	<p>Module: Laplace Transform</p> <p>1.1 Definition of Laplace transform, Condition of Existence of Laplace transform,</p> <p>1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$.</p> <p>1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof).</p> <p>1.4 Evaluation of real integrals by using Laplace Transformation.</p> <p>Self-learning Topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.</p>	7	CO1
02	<p>Module: Inverse Laplace Transform</p> <p>2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives,</p> <p>2.2 Partial fractions method to find inverse Laplace transform.</p> <p>2.3 Inverse Laplace transform using Convolution theorem (without proof)</p> <p>Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations</p>	6	CO1, CO2
03	<p>Module: Fourier Series:</p> <p>3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity(without proof)</p> <p>3.2 Fourier series of periodic function with period 2π and $2l$,</p> <p>3.3 Fourier series of even and odd functions</p> <p>3.4 Half range Sine and Cosine Series.</p> <p>Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.</p>	7	CO3

04	<p>Module: Complex Variables:</p> <p>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),</p> <p>4.2 Cauchy-Riemann equations in cartesian coordinates (without proof)</p> <p>4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given.</p> <p>4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories</p> <p>Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations</p>	7	CO4
05	<p>Module: Statistical Techniques</p> <p>5.1 Karl Pearson's Coefficient of correlation (r)</p> <p>5.2 Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)</p> <p>5.3 Lines of regression</p> <p>5.4 Fitting of first and second degree curves.</p> <p>Self-learning Topics: Covariance, fitting of exponential curve.</p>	6	CO5
06	<p>Module: Probability</p> <p>6.1 Definition and basics of probability, conditional probability,</p> <p>6.2 Total Probability Theorem and Baye's theorem</p> <p>6.3 Discrete and continuous random variable with probability distribution and probability density function.</p> <p>6.4 Expectation of random variables with mean, variance and standard deviation, moment generating function up to four moments.</p> <p>Self-learning Topics: Skewness and Kurtosis of distribution (data)</p>	6	CO6

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.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. 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 should be considered as mini project in Engineering Mathematics. This project should be graded for 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:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
 2. Total 04 questions need to be solved.
 3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
 4. Remaining questions will be randomly selected from all the modules.
 5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC302	Data Structure and Analysis	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC302	Data Structure and Analysis	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	The fundamental knowledge of data structures.
2	The programming knowledge which can be applied to sophisticated data structures.
3	The fundamental knowledge of stacks queue, linked list etc.
4	The fundamental knowledge of Trees, Graphs etc.
5	The fundamental knowledge of different sorting, searching, hashing and recursion techniques
6	The real time applications for stacks, queue, linked list, trees, graphs etc.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Classify and Apply the concepts of stacks, queues and linked list in real life problem solving.	L1, L2, L3
2	Classify, apply and analyze the concepts trees in real life problem solving.	L2, L3,L4
3	Illustrate and justify the concepts of graphs in real life problem solving.	L3, L5
4	List and examine the concepts of sorting, searching techniques in real life problem solving.	L2, L3, L4
5	Use and identify the concepts of recursion, hashing in real life problem solving.	L3, L4
6	Examine and justify different methods of stacks, queues, linked list, trees and graphs to various applications.	L3, L4, L5

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Defining, Declaring and Initialization of structure variables. Accessing members of a structure, Array of structures, Nested structures, Pointers to structures. Passing structure, structure members, structure arrays and pointer to structure as function parameters. Self-referential structures.	02	---
I	Introduction to Stacks, Queues and Linked Lists	<p>Introduction to Data Structures: Linear and Non Linear Data Structures, Static and Dynamic Data Structures.</p> <p>Concept of Stack and Queue. Array Implementation of Stack and Queue, Circular Queue, Double Ended Queue, Priority Queue.</p> <p>Concept of Linked Lists. Singly linked lists, doubly linked lists and circular linked lists.</p> <p>Insertion, deletion, update and copying operations with Singly linked lists, doubly linked lists and circular linked lists. Reversing a singly linked list.</p> <p>Self-learning Topics: Linked List Implementation of Stack, Linked List implementation of Queue, Circular Queue, Double Ended Queue, Priority Queue.</p>	08	CO1
II	Trees	<p>Introduction to Trees: Terminology, Types of Binary trees.</p> <p>Non recursive Preorder, in-order and post-order traversal. Creation of binary trees from the traversal of binary trees.</p> <p>Binary search tree: Traversal, searching, insertion and deletion in binary search tree.</p> <p>Threaded Binary Tree: Finding in-order successor and predecessor of a node in threaded tree. Insertion and deletion in threaded binary tree.</p> <p>AVL Tree: Searching and traversing in AVL trees. Tree Rotations: Right Rotation, Left Rotation. Insertion and Deletion in an AVL Tree.</p> <p>B-tree: Searching, Insertion, Deletion from leaf node and non-leaf node.</p> <p>B+ Tree, Digital Search Tree, Game Tree & Decision Tree</p> <p>Self-learning Topics: Implementation of AVL and B+ Tree</p>	07	CO1, CO 2
III	Graphs	<p>Introduction to Graphs: Undirected Graph, Directed Graph, graph terminology, Connectivity in Undirected and Directed Graphs. Spanning tree.</p> <p>Representation of graph: adjacency matrix, adjacency list, Transitive closure of a directed graph and path matrix.</p>	05	CO1, CO3

		<p>Traversals: Breadth First Search, Depth First Search.</p> <p>Self-learning Topics: Implementation of BFS, DFS</p>		
IV	Recursion and Storage Management	<p>Recursion: Writing a recursive function, Flow of control in recursive functions, Winding and unwinding phase, Recursive data structures, Implementation of recursion. Tail recursion. Indirect and Direct Recursion.</p> <p>Storage Management: Sequential Fit Methods: First Fit, Best Fit and Worst Fit methods. Fragmentation, Freeing Memory, Boundary Tag Method. Buddy Systems: Binary Buddy System, Fibonacci Buddy System. Compaction, Garbage Collection.</p> <p>Self-learning Topics: Implementation of recursion function.</p>	06	CO5
V	Searching and Sorting	<p>Searching: Sequential Search, Binary Search. Hashing: Hash Functions: Truncation, Mid-square Method, Folding Method, Division Method. Collision Resolution: Open Addressing: Linear Probing, Quadratic Probing, Double Hashing, Separate Chaining Bucket Hashing. Analysis of all searching techniques</p> <p>Sorting: Insertion sort, Selection sort, Merge sort, Quick sort and Radix sort. Analysis of all sorting techniques</p> <p>Self-learning Topics: Implementation of different sorting techniques and searching.</p>	05	CO 4, CO5
VI	Applications of Data Structures	<p>Applications of Linked Lists: Addition of 2 Polynomials and Multiplication of 2 polynomials.</p> <p>Applications of Stacks: Reversal of a String, Checking validity of an expression containing nested parenthesis, Function calls, Polish Notation: Introduction to infix, prefix and postfix expressions and their evaluation and conversions.</p> <p>Application of Queues: Scheduling, Round Robin Scheduling</p> <p>Applications of Trees: Huffman Tree and Heap Sort.</p> <p>Applications of Graphs: Dijkstra's Algorithm, Minimum Spanning Tree: Prim's Algorithm, Kruskal's Algorithm.</p> <p>Self-learning Topics: Implementation of applications for Stack, Queues, Linked List, Trees and Graph.</p>	06	CO6

Text Books:

1. S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India; 1996.
3. Reema Thareja; Data Structures using C; Oxford.

References:

1. Ellis Horowitz, Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications; 2010.
2. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGrawHill; 1984.
3. Rajesh K. Shukla; Data Structures using C and C++; Wiley India; 2009.

Online References:

Sr. No.	Website Name
2.	https://www.nptel.ac.in
3.	https://opendatastructures.org/
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks**. Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC303	Database Management System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC303	Database Management System	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To learn the basics and understand the need of database management system.
2	To construct conceptual data model for real world applications
3	To Build Relational Model from ER/EER.
4	To introduce the concept of SQL to store and retrieve data efficiently.
5	To demonstrate notions of normalization for database design.
6	To understand the concepts of transaction processing- concurrency control & recovery procedures.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Identify the need of Database Management System.	L1, L2
2	Design conceptual model for real life applications.	L6
3	Create Relational Model for real life applications	L6
4	Formulate query using SQL commands.	L3
5	Apply the concept of normalization to relational database design.	L3
6	Demonstrate the concept of transaction, concurrency and recovery.	L2

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Comment Basic knowledge of operating systems and file systems, Any programming	02	--
I	Database System Concepts and Architecture	Introduction, Characteristics of Databases, File system v/s Database system, Data abstraction and Data Independence, DBMS system architecture, Database Administrator (DBA), Role of DBA Self-learning Topics: Identify the types of Databases.	05	CO1
II	The Entity-Relationship Model	Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Type, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Weak entity Types Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model. Self-learning Topics: Design an ER model for any real time case study.	05	CO2
III	Relational Model & Relational Algebra	Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Key, Secondary key, Foreign Key, Mapping the ER and EER Model to the Relational Model, Introduction to Relational Algebra, Relational Algebra expressions for Unary Relational Operations, <ul style="list-style-type: none"> • Set Theory operations, • Binary Relational operation Relational Algebra Queries Self-learning Topics: Map the ER model designed in module II to relational schema..	05	CO3
IV	Structured Query Language (SQL) & Indexing	Overview of SQL, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands, Complex Retrieval Queries using Group By, Recursive Queries, nested Queries ; Integrity constraints in SQL. Database Programming with JDBC, Security and authorization: Grant & Revoke in SQL Functions and Procedures in SQL and cursors. Indexing:Basic Concepts, Ordered Indices, Index Definition in SQL Self-learning Topics: Physical design of database for the relational model designed in module III and fire various queries.	08	CO4

V	Relational Database Design	Design guidelines for relational Schema, Functional Dependencies, Database tables and normalization, The need for normalization, The normalization process, Improving the design, Definition of Normal Forms- 1NF, 2NF, 3NF & The Boyce-Codd Normal Form (BCNF). Self-learning Topics: Consider any real time application and normalization upto 3NF/BCNF	07	CO5
VI	Transactions Management and Concurrency and Recovery	Transaction: Transaction concept, State Diagram, ACID Properties, Transaction Control Commands, Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based-protocols, Deadlock handling Timestamp-based protocols, Recovery System: Recovery Concepts, Log based recovery. Self-learning Topics: Study the various deadlock situation which may occur for a database designed in module V.	07	CO6

Text Books:

1. Korth, Sliberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, — Database Systems Design, Implementation and Managementl, Thomson Learning, 9th Edition.
2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
3. G. K. Gupta : “Database Management Systems”, McGraw – Hill

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.oreilly.com
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC304	Principle of Communication	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC304	Principle of Communication	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	Study the basic of Analog and Digital Communication Systems.
2	Describe the concept of Noise and Fourier Transform for analyzing communication systems.
3	Acquire the knowledge of different modulation techniques such as AM, FM and study the block diagram of transmitter and receiver.
4	Study the Sampling theorem and Pulse Analog and digital modulation techniques
5	Learn the concept of multiplexing and digital band pass modulation techniques
6	Gain the core idea of electromagnetic radiation and propagation of waves.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Describe analog and digital communication systems	L1,L2
2	Differentiate types of noise, analyses the Fourier transform of time and frequency domain.	L1, L2, L3, L4
3	Design transmitter and receiver of AM, DSB, SSB and FM.	L1,L2,L3,L4
4	Describe Sampling theorem and pulse modulation systems.	L1,L2,L3
5	Explain multiplexing and digital band pass modulation techniques.	L1, L2
6	Describe electromagnetic radiation and propagation of waves.	L1,L2

Prerequisite: Basic of electrical engineering

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Terminologies in communication systems, analog and digital electronics	02	
I	Introduction	Basics of analog communication and digital communication systems (Block diagram), Electromagnetic Spectrum and application, Types of Communication channels. Self-learning Topics: Applications areas of analog and digital communication.	03	CO1
II	Noise and Fourier Representation of Signal and System	Basics of signal representation and analyses, Introduction to Fourier Transform, its properties (time and frequency shifting, Fourier transform of unit step, delta and gate function. Types of Noise, Noise parameters –Signal to noise ratio, Noise factor, Noise figure, Friss formula and Equivalent noise temperature. Self-learning Topics: Practice Numerical on above topic.	06	CO2
III	Amplitude and Angle modulation Techniques.	Need for modulation, Amplitude Modulation Techniques: DSBFC AM,DSBSC-AM, SSB SC AM- block diagram spectrum, waveforms, bandwidth, Power calculations. Generation of AM using Diode, generation of DSB using Balanced modulator, Generation of SSB using Phase Shift Method. AM Transmitter (Block Diagram) AM Receivers – Block diagram of TRF receivers and Super heterodyne receiver and its characteristics- Sensitivity, Selectivity, Fidelity, Image frequency and its rejection and double spotting Angle Modulation FM: Principle of FM- waveforms, spectrum, bandwidth. Pre- emphasis and de-emphasis in FM, FM generation: Direct method –Varactor diode Modulator, Indirect method (Armstrong method) block diagram and waveforms. FM demodulator: Foster Seeley discriminator, Ratio detector. Self-learning Topics: Use of AM and FM in Modern Communication Technology. Challenges faced by radio business.	12	CO1, CO2, CO3
IV	Pulse Analog Modulation and Digital Modulation	Sampling theorem for low pass and band pass signals with proof, Anti- aliasing filter, PAM, PWM and PPM generation and Degeneration. Quantization process, Pulse code modulation, Delta modulation, Adaptive delta modulation. Introduction to Line Codes and ISI.	08	CO1, CO2, CO4

		Self-learning Topics: Implementation of Pulse code modulation and demodulation.		
V	Multiplexing and Digital Band Pass Modulation Techniques	Principle of Time Division Multiplexing, Frequency Division Multiplexing , Orthogonal Frequency Division Multiplexing and its applications .ASK, FSK, PSK QPSK Generation and detection. Self-learning Topics: Implement TDM, FDM, OFDM.	04	CO1, CO2, CO5
VI	Radiation and Propagation of Waves	Electromagnetic radiation, fundamentals, types of propagation, ground wave, sky wave, space wave tropospheric scatter propagation Self-learning Topics: List the real time examples for different types of propagation waves.	04	CO6

Text Books:

- [1]. George Kennedy, Bernard Davis, SRM Prasanna, Electronic Communication Systems, Tata McGraw Hill, 5th Ed
[2]. Simon Haykin, Michael Moher, Introduction to Analog & Digital Communications, Wiley India Pvt. Ltd., 2nd Ed.
[3]. Wireless Communication and Networking, Vijay Garg

References:

- [1]. Wayne Tomasi, Electronic Communications Systems, Pearson Publication, 5th Ed.
[2]. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University
[3]. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, Tata McGraw Hill, 3rdEd.
[4]. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt. Ltd, 1st Ed.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.classcentral.com
3.	http://www.vlab.co.in/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC305	Paradigms and Computer Programming Fundamentals	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC305	Paradigms and Computer Programming Fundamentals	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To introduce various programming paradigms and the basic constructs that underline any programming language.
2	To understand data abstraction and object orientation
3	To introduce the basic concepts of declarative programming paradigms through functional and logic programming.
4	To design solutions using declarative programming paradigms through functional and logic programming.
5	To introduce the concepts of concurrent program execution.
6	To understand use of scripting language for different problem domains

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and Compare different programming paradigms.	L1, L2
2	Understand the Object Oriented Constructs and use them in program design.	L1, L2
3	Understand the concepts of declarative programming paradigms through functional and logic programming.	L1, L2
4	Design and Develop programs based on declarative programming paradigm using functional and/or logic programming.	L5, L6
5	Understand the role of concurrency in parallel and distributed programming.	L1, L2
6	Understand different application domains for use of scripting languages.	L1, L2

Prerequisite: Students must have learned C Programming (FEC205 and FEL204),

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Compilation and interpretation Focus on overview of compilation steps.	02	CO1
I	Introduction to Programming Paradigms and Core Language Design Issues	Introduction to different programming paradigms. Names, Scopes, and Bindings, Scope Rules, Storage Management. Type Systems, Type Checking, Equality Testing and Assignment. Subroutine and Control Abstraction: Stack Layout, Calling sequence, parameter passing Generic subroutines and modules. Exception handling, Coroutines and Events. Self-Learning Topic: Implementation of basic concepts using programming language.	10	CO1
II	Imperative Paradigm: Data Abstraction in Object Orientation	Grouping of data and Operations- Encapsulation, Overloading, Polymorphism, Inheritance, Initialization and Finalization, Dynamic Binding. Self-Learning Topic: Implementation of OOP concepts using preferably C++ and Java language.	05	CO2
III	Declarative Programming Paradigm: Functional Programming	Introduction to Lambda Calculus, Functional Programming Concepts, Evaluation order, Higher order functions, I/O-Streams and Monads. Self-Learning Topic: Implementation of programs using functional programming Language Haskell can refer to hacker rank website for problem statements.	07	CO3, CO4
IV	Declarative Programming Paradigm: Logic Programming	Logic Programming with PROLOG - Resolution and Unification, Lists, Arithmetic execution order, imperative control flow, database manipulation, PROLOG facilities and deficiencies. Self-Learning Topic: Identification of different application domains for use of Prolog and Logic programming	06	CO3, CO4
V	Alternative Paradigms: Concurrency	Concurrent Programming Fundamentals, Implementing synchronisation, Message Passing - Background and Motivation, Multithreaded programs, Communication and Synchronization, Language and Libraries, Thread creation Syntax. Self-Learning Topic: Study Implementation of concurrency concepts for real time application.	04	CO5
VI	Alternative Paradigms: Scripting Languages	Common characteristics, Different Problem domains for using scripting, Use of scripting in Web development–server and clients side scripting, Innovative features of scripting languages - Names and Scopes, string and pattern manipulation, data types, object orientation.	05	CO6

		Self-Learning Topic: Review small client server application code in any scripting language to realise applicability of features learned in Module.		
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Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016
3. Programming Languages: Concepts and Constructs; 2nd Edition, Ravi Sethi, Pearson Education Asia, 1996.

References:

1. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition) (February 2, 2016)
2. Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000
3. Rajkumar Buyya, Object-oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited
4. Max Bramer, Logic Programming with Prolog, Springer ISBN-13: 978-1852-33938-8

Online References:

Sr No	Website Name	Link
<u>1</u>	Principles of programming Languages (Videos)	https://nptel.ac.in/courses/106/102/106102067/
2	Edx course Paradigms of Computer Programming – Fundamentals	https://www.classcentral.com/course/edx-paradigms-of-computer-programming-fundamentals-2298
3	Udemy Couses	https://www.udemy.com

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

► **Question paper format**

- Question Paper will comprise of a total of six questions each carrying 20 marks Q.1 will be compulsory and should cover maximum contents of the syllabus.
 - Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of four questions need to be answered
-

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL301	Data Structure Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL301	Data Structure Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To use data structures as the introductory foundation for computer automation to engineering problems.
2	To use the basic principles of programming as applied to complex data structures.
3	To learn the principles of stack, queue, linked lists and its various operations.
4	To learn fundamentals of binary search tree, implementation and use of advanced tree like AVL, B trees and graphs.
5	To learn about searching, hashing and sorting.
6	To learn the applications of linked lists, stacks, queues, trees and graphs.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and use the basic concepts and principles of various linked lists, stacks and queues.	L1, L2, L3
2	Understand the concepts and apply the methods in basic trees.	L1, L2
3	Use and identify the methods in advanced trees.	L3, L4
4	Understand the concepts and apply the methods in graphs.	L2, L3
5	Understand the concepts and apply the techniques of searching, hashing and sorting	L2, L3
6	Illustrate and examine the methods of linked lists, stacks, queues, trees and graphs to various real time problems	L3, L4

Prerequisite: C Programming

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: Turbo/Borland C complier
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DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Introduction of C programming language.	02	----
I	Stacks, Queues and Linked Lists	<ul style="list-style-type: none">• Array Implementation of Stack and Queue.• Insertion, deletion operations with Singly linked lists• Insertion, deletion operations Doubly linked lists• Insertion, deletion operations Circular linked lists.• Reversing a singly linked list.• * Linked List implementation of Stack and Queue	04	LO 1
II	Trees	<ul style="list-style-type: none">• * Implementation of operations (insertion, deletion, counting of nodes, counting of leaf nodes etc.) in a binary search tree.• Implementation of insertion, deletion and traversal for fully in-threaded binary search tree.	04	LO 2
III	Advanced Trees	<ul style="list-style-type: none">• * Implementation of AVL tree.• Implementation of operations in a B tree.	04	LO 3
IV	Graphs	<ul style="list-style-type: none">• Implementation of adjacency matrix creation.• Implementation of addition and deletion of edges in a directed graph using adjacency matrix.• Implementation of insertion and deletion of vertices and edges in a directed graph using adjacency list.•	04	LO 4
V	Searching and Sorting	<ul style="list-style-type: none">• Implementation of Heap Sort• Implementation of Binary Search.• Implementation of Selection sort, Bubble sort, Insertion sort, Quick sort	04	LO 5

VI	Applications of Data Structures	<ul style="list-style-type: none"> • * Implementation of infix to postfix conversion and evaluation of postfix expression • * Implementation of Josephus Problem using circular linked list • * Implementation of traversal of a directed graph through BFS and DFS. • Implementation of finding shortest distances using Dijkstra's algorithm • *Implementation of hashing functions with different collision resolution techniques 	04	LO 6
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Text Books:

1. S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India; 1996.
3. Reema Thareja; Data Structures using C; Oxford.

References:

1. Ellis Horowitz, Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications; 2010.
2. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGrawHill; 1984.
3. Rajesh K. Shukla; Data Structures using C and C++; Wiley India; 2009.

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL302	SQL Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL302	SQL Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To identify and define problem statements for real life applications
2	To construct conceptual data model for real life applications
3	To Build Relational Model from ER/EER and demonstrate usage of relational algebra.
4	To Apply SQL to store and retrieve data efficiently
5	To implement database connectivity using JDBC
6	To understand the concepts of transaction processing- concurrency control & recovery procedures.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define problem statement and Construct the conceptual model for real life application.	L1, L3, L4, L6
2	Create and populate a RDBMS using SQL.	L3, L4
3	Formulate and write SQL queries for efficient information retrieval	L3, L4
4	Apply view, triggers and procedures to demonstrate specific event handling.	L1, L3, L4
5	Demonstrate database connectivity using JDBC.	L3
6	Demonstrate the concept of concurrent transactions.	L3, L4

Prerequisite: C Programming

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: Any SQL Compiler, Java Programming Language
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DETAILED SYLLABUS:

Sr. No.	Detailed Content	Hours	LO Mapping
1.	Identify real world problem and develop the problem statement. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.	02	LO1
2.	Mapping ER/EER to Relational schema model.	02	LO1
3.	Create a database using DDL and apply integrity constraints.	02	LO2, LO3
4.	Perform data manipulations operations on populated database.	02	LO3
5.	Perform Authorization using Grant and Revoke.	02	LO2, LO3
6.	Implement Basic and complex SQL queries.	02	LO3, LO4
7.	Implementation of Views and Triggers.	02	LO4
8.	Demonstrate database connectivity using JDBC.	02	LO5
9.	Execute TCL commands.	02	LO4
10.	Implement functions and procedures in SQL	02	LO3, LO4
11.	Implementation of Cursor.	02	LO3, LO4
12.	Implementation and demonstration of Transaction and Concurrency control techniques using locks.	02	LO6

Text Books:

1. Korth, Silberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, — Database Systems Design, Implementation and Management, Thomson Learning, 9th Edition.
 2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
 3. G. K. Gupta : “Database Management Systems”, McGraw – Hill
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Term Work:

Term Work shall consist of at least 10 Practical's based on the above list, but not limited to. Also, Term work Journal must include at least 2 assignments:

The first assignment may be based on: Relational Algebra and Second may be based on Transactions

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL303	Computer programming Paradigms Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL303	Computer programming Paradigms Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Understand data abstraction and object orientation
2	Design and implement declarative programs in functional and logic programming languages
3	Introduce the concepts of concurrent program execution
4	Understand run time program management
5	Understand how to implement a programming solution using different programming paradigms.
6	Learn to compare implementation in different programming paradigms.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Implement Object Oriented concepts in C++.	L1, L2, L3
2	Design and Develop solution based on declarative programming paradigm using functional and logic programming.	L6
3	Understand the multi threaded programs in Java and C++	L1, L2
4	Understand the need and use of exception handling and garbage collection in C++ and JAVA	L2, L3
5	Implement a solution to the same problem using multiple paradigms.	L6
6	Compare the implementations in multiple paradigms at coding and	L4

execution level.	
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Prerequisite: Students must have learned C Programming (FEC205 and FEL204)

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: C++ compiler, Java Language support, SWI Prolog, GHC Compiler.
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DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Demonstrate Compilation and interpretation stages to students for C, C++, JAVA along with how to debug the code.	02	--
I	Imperative Paradigm: Data Abstraction in Object Orientation	At least two Programming Implementations Preferably in C++ to demonstrate concepts like - Encapsulation, Inheritance, Initialization and Finalization, Dynamic Binding.	05	LO1
II	Declarative Programming Paradigm: Functional Programming	<ul style="list-style-type: none"> • Tutorial Introduction to Haskell programming environment • Tutorial exercise on operators, types etc. in Haskell • At least 5 Haskell Programs to demonstrate Functional Programming Concepts. • Sample Programs but not limited to: <ul style="list-style-type: none"> ◦ Implement safetail function that behaves in the same way as tail, except that safetail maps the empty list to the empty list, whereas tail gives an error in this case. Define safetail using: (a) a conditional expression; (b) guarded equations; (c) pattern matching. Hint: the library function null :: [a]-> Bool can be used to test if a list is empty. ◦ Simple List Comprehension ◦ Higher-Order Functions ◦ Write recursive function to multiply two natural numbers that uses pre defined add funion. ◦ Implement the game of nim in Haskell to apply list processing. ◦ Haskell code to represent infinite list e.g. fibonacci series ◦ Implement simple Calculator <p>Students should clearly understand the syntax and the execution of the Functional Implementation using Haskell.</p>	06	LO2

III	Declarative Programming Paradigm: Logic Programming	<ul style="list-style-type: none"> Tutorial Installation and working of SWI Prolog Environment Implement at least 5 Prolog programs to understand declarative programming concepts. <p>Students should clearly understand the syntax and the execution of the Prolog code Implementation.</p>	05	LO2
IV	Alternative Paradigms: Concurrency	At least two Programs preferably in c++ and java to demonstrate Thread management and synchronization	02	LO4
V	Run Time Program Management	A Program to understand Exception handling and Garbage collection, preferably in C++ and JAVA Students should understand the syntactic differences in the solutions in both Object Oriented Languages.	02	LO4
VI	Programming Assignment For comparative study of Different Paradigms	At Least two implementations each implemented on multiple paradigms like procedural, object oriented, functional, logic. The implementations should be done in a group of two/three students with appropriate difficulty level. Student should prepare small report and present the solution code and demonstrate execution for alternative solutions they build.	04	LO5, LO6

Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition)
3. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016
- 4.

References:

1. Sethi R, Programming Languages Concepts and Constructs , 2nd Ed, Pearson Education
2. Yogesh Sajanikar, Haskell Cookbook, Packt Publishing, 2017

Online References:

Sr No	Website Description	Link
1	University Stuttgart Germany Lab Course on Programming Paradigms	http://software-lab.org/teaching/winter2019/pp/
2	Course at MIT Structure and Interpretation of Computer Programs [2019]	https://web.mit.edu/u/6.037
3	Edx Course Paradigms of Computer Programming – Fundamentals,	https://www.edx.org/course/paradigms-of-computer-programming-fundamentals
4	Tutorials point link for Haskell	https://www.tutorialspoint.com/haskell

Term Work: Term Work shall consist of at least 15 Practicals based on the above modules, but not limited to. Also, Term work Journal must include at least 3 tutorial reports and 01 report of programming assignment

as mentioned in module VI.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments/Tutorials) + 5 Marks (Assignment write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & 1 Hr Practical exam will be held based on the above syllabus

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL304	Java Lab (SBL)	--	04	--	--	02	--	02

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL304	Java Lab (SBL)	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To understand the concepts of object-oriented paradigm in the Java programming language.
2	To understand the importance of Classes & objects along with constructors, Arrays ,Strings and vectors
3	To learn the principles of inheritance, interface and packages and demonstrate the concept of reusability for faster development.
4	To recognize usage of Exception Handling, Multithreading, Input Output streams in various applications
5	To learn designing, implementing, testing, and debugging graphical user interfaces in Java using Swings and AWT components that can react to different user events.
6	To develop graphical user interfaces using JavaFX controls.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Explain the fundamental concepts of Java Programing.	L1, L2
2	Use the concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem.	L3
3	Demonstrate how to extend java classes and achieve reusability using Inheritance, Interface and Packages.	L3
4	Construct robust and faster programmed solutions to problems using concept of Multithreading, exceptions and file handling	L3
5	Design and develop Graphical User Interface using Abstract Window Toolkit and Swings along with response to the events.	L6
6	Develop Graphical User Interface by exploring JavaFX framework based on MVC architecture.	L6

Prerequisite: Basics of Computer Programming

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 2 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. JDK 1.8 or higher 3. Notepad ++ 4. JAVA IDEs like Netbeans or Eclipse	1. Internet Connection for installing additional packages if required

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basics of Computer Programming.	02	-
I	Java Fundamentals	<p>Overview of procedure and object oriented Programming, Java Designing Goals and Features of Java Language.</p> <p>Introduction to the principles of object-oriented programming: Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism.</p> <p>Keywords, Data types, Variables, Operators, Expressions, Types of variables and methods.</p> <p>Control Statements: If Statement, If-else, Nested if, switch Statement, break, continue.</p> <p>Iteration Statements: for loop, while loop, and do-while loop</p> <p>(Perform any 2 programs that covers Classes, Methods, Control structures and Looping statements)</p> <p>1) Implement a java program to calculate gross salary & net salary taking the following data. Input: empno, empname, basic Process: DA=70% of basic HRA=30% of basic CCA=Rs240/- PF=10% of basic PT= Rs100/-</p> <p>2) Five Bikers Compete in a race such that they drive at a constant speed which may or may not be the same as the other. To qualify the race, the speed of a racer must be more than the average speed of all 5 racers. Write a Java program to take as input the speed of each racer and print back the speed of qualifying racers.</p> <p>3) Write a Java program that prints all real solutions to the quadratic equation $ax^2+bx+c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate b^2-4ac is negative, display a message stating that there are no real solutions?</p> <p>4) Write a Menu driven program in java to implement simple banking application. Application should read</p>	07	LO1

		<p>the customer name, account number, initial balance, rate of interest, contact number and address field etc. Application should have following methods.</p> <ol style="list-style-type: none"> 1. createAccount() 2. deposit() 3. withdraw() 4. computeInterest() 5. displayBalance() <p>5) Write a menu driven Java program which will read a number and should implement the following methods</p> <ol style="list-style-type: none"> 1. factorial() 2. testArmstrong() 3. testPalindrome() 4. testPrime() 5. fibonacciSeries() <p>6) Create a Java based application to perform various ways of Method overloading.</p>														
II	Classes, objects, Arrays and Strings	<p>Classes & Objects: Reference Variables, Passing parameters to Methods and Returning parameters from the methods, Static members, Non-Static members Nested and Inner Classes. Static Initialization Block(SIB), Instance Initialization Block(IIB)</p> <p>Constructors: Parameterized Constructors, chaining of constructor, finalize() Method, Method overloading, Constructors Overloading.</p> <p>Recursion, Command-Line Arguments. Wrapper classes, InputBufferReader, OutputBufferReader, String Buffer classes, String functions.</p> <p>Arrays & Vectors: One and Two Dimensional arrays, Irregular arrays, dynamic arrays, Array List and Array of Object.</p> <p>(Perform any 3 programs that covers Classes & objects, Constructors, Command Line Arguments, Arrays/Vectors,String function and recursions).</p> <p>Experiments:</p> <p>1) Write a program that would print the information (name, year of joining, salary, address) of three employees by creating a class named 'Employee'. The output should be as follows:</p> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Name</th> <th>Year of joining</th> <th>Address</th> </tr> </thead> <tbody> <tr> <td>Robert</td> <td>1994</td> <td>64C- WallsStreat</td> </tr> <tr> <td>Sam</td> <td>2000</td> <td>68D- WallsStreat</td> </tr> <tr> <td>John</td> <td>1999</td> <td>26B- WallsStreat</td> </tr> </tbody> </table> <p>2) Write a program to print the area of a rectangle by creating a class named 'Area' having two methods. First method named as 'setDim' takes length and breadth of rectangle as parameters and the second method named as 'getArea' returns the area of the rectangle. Length and breadth of rectangle are entered through keyboard.</p> <p>3) Write a Java program to illustrate Constructor Chaining.</p>	Name	Year of joining	Address	Robert	1994	64C- WallsStreat	Sam	2000	68D- WallsStreat	John	1999	26B- WallsStreat	07	LO1 LO2
Name	Year of joining	Address														
Robert	1994	64C- WallsStreat														
Sam	2000	68D- WallsStreat														
John	1999	26B- WallsStreat														

		<p>4) Create a class 'Student' with three data members which are name, age and address. The constructor of the class assigns default values name as "unknown", age as '0' and address as "not available". It has two members with the same name 'setInfo'. First method has two parameters for name and age and assigns the same whereas the second method takes has three parameters which are assigned to name, age and address respectively. Print the name, age and address of 10 students. Hint - Use array of objects.</p> <p>5) Write a java programs to add n strings in a vector array. Input new string and check whether it is present in the vector. If it is present delete it otherwise add it to the vector.</p> <p>6) Print the sum, difference and product of two complex numbers by creating a class named 'Complex' with separate methods for each operation whose real and imaginary parts are entered by user.</p> <p>7)Write menu driven program to implement recursive Functions for following tasks.</p> <p>a) To find GCD and LCM b) To print n Fibonacci numbers c) To find reverse of number d) To solve $1 + 2 + 3 + 4 + \dots + (n - 1) + n$</p> <p>8) Print Reverse Array list in java by writing our own function.</p>		
III	Inheritance, Packages and Interfaces.	<p>Inheritance: Inheritance Basics, Types of Inheritance in Java, member access, using Super- to call superclass Constructor, to access member of super class(variables and methods), creating multilevel hierarchy, Constructors in inheritance, method overriding, Abstract classes and methods, using final, Dynamic Method Dispatch</p> <p>Packages: Defining packages, creating packages and Importing and accessing packages</p> <p>Interfaces: Defining, implementing and extending interfaces, variables in interfaces, Default Method in Interface ,Static Method in interface, Abstract Classes vs Interfaces.</p> <p>(Perform any 3 programs covering Inheritance, Interfaces and Packages).</p> <p>Experiments</p> <p>1) Create a Teacher class and derive Professor/ Associate_Professor/Assistant_Professor class from Teacher class. Define appropriate constructor for all the classes. Also define a method to display information of Teacher. Make necessary assumptions as required.</p> <p>2) Create a class Book and define a display method to display book information. Inherit Reference_Book and Magazine classes from Book class and override display method of Book class in Reference_Book and Magazine classes. Make necessary assumptions required.</p>	10	LO1 LO3

3) A university has two types of students — graduate students and research students. The University maintains the record of name, age and programme of every student. For graduate students, additional information like percentage of marks and stream, like science, commerce, etc. is recorded; whereas for research students, additionally, specialization and years of working experience, if any, is recorded. Each class has a constructor. The constructor of subclasses makes a call to constructor of the superclass. Assume that every constructor has the same number of parameters as the number of instance variables. In addition, every subclass has a method that may update the instance variable values of that subclass. All the classes have a function `display_student_info()`, the subclasses must override this method of the base class. Every student is either a graduate student or a research student.

Perform the following tasks for the description given above using Java :

- (i) Create the three classes with proper instance variables and methods, with suitable inheritance.
- (ii) Create at least one parameterised constructor for each class.
- (iii) Implement the `display_student_info()` method in each class.

4) An employee works in a particular department of an organization. Every employee has an employee number, name and draws a particular salary. Every department has a name and a head of department. The head of department is an employee. Every year a new head of department takes over. Also, every year an employee is given an annual salary enhancement. Identify and design the classes for the above description with suitable instance variables and methods. The classes should be such that they implement information hiding. You must give logic in support of your design. Also create two objects of each class.

5) Consider a hierarchy, where a sportsperson can either be an athlete or a hockey player. Every sportsperson has a unique name. An athlete is characterized by the event in which he/she participates; whereas a hockey player is characterised by the number of goals scored by him/her.

Perform the following tasks using Java :

- (i) Create the class hierarchy with suitable instance variables and methods.
- (ii) Create a suitable constructor for each class.
- (iii) Create a method named `display_all_info` with suitable parameters. This method should display all the information about the object of a class.
- (iv) Write the main method that demonstrates polymorphism.

6) Create an interface `vehicle` and classes like `bicycle`,

		<p>car, bike etc, having common functionalities and put all the common functionalities in the interface. Classes like Bicycle, Bike, car etc implement all these functionalities in their own class in their own way</p> <p>7) Create a class "Amount In Words" within a user defined package to convert the amount into words. (Consider amount not to be more than 100000).</p>		
IV	Exception Handling, Multithreading, Input Output streams	<p>Exception Handling: Exception-Handling Fundamentals, Exception Types, Exception class Hierarchy, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally , Java's Built-in Exceptions, Creating Your Own Exception Subclasses</p> <p>Multithreaded Programming: The Java Thread Model and Thread Life Cycle, Thread Priorities, Creating a Thread, Implementing Runnable, Extending Thread, Creating Multiple Threads, Synchronization: Using Synchronized Methods, The synchronized Statement</p> <p>I/O Streams: Streams, Byte Streams and Character, The Predefined Streams, Reading Console Input, Reading Characters, Reading Strings, Writing Console Output, Reading and Writing Files.</p> <p>(Perform any 3 programs that cover Exception Handling, Multithreading and I/O Streams).</p> <p>Experiments:</p> <p>1) Write java program where user will enter loginid and password as input. The password should be 8 digit containing one digit and one special symbol. If user enter valid password satisfying above criteria then show "Login Successful Message". If user enter invalid Password then create InvalidPasswordException stating Please enter valid password of length 8 containing one digit and one Special Symbol.</p> <p>2) Java Program to Create Account with 1000 Rs Minimum Balance, Deposit Amount, Withdraw Amount and Also Throws LessBalanceException. It has a Class Called LessBalanceException Which returns the Statement that Says WithDraw Amount(_Rs) is Not Valid. It has a Class Which Creates 2 Accounts, Both Account Deposite Money and One Account Tries to WithDraw more Money Which Generates a LessBalanceException Take Appropriate Action for the Same.</p> <p>3) Create two threads such that one thread will print even number and another will print odd number in an ordered fashion.</p> <p>4) Assume that two brothers, Joe and John, share a common bank account. They both can, independently, read the balance, make a deposit, and withdraw some</p>	10	LO1 LO3 LO4

		<p>money. Implement java application demonstrate how the transaction in a bank can be carried out concurrently.</p> <p>5) You have been given the list of the names of the files in a directory. You have to select Java files from them. A file is a Java file if it's name ends with ".java". For e.g. File- "Names.java" is a Java file, "FileNames.java.pdf" is not.</p> <p>Input: test.java, ABC.doc, Demo.pdf, add.java, factorial.java, sum.txt</p> <p>Output: tset.java, add.java, factorial.java</p>		
V	GUI programming- I (AWT, Event Handling, Swing)	<p>Designing Graphical User Interfaces in Java: Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features</p> <p>Event-Driven Programming in Java: Event-Handling Process, Event-Handling Mechanism, Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling.</p> <p>Introducing Swing: AWT vs Swings, Components and Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbar</p> <p>(Perform any 3 programs that contain AWT, Event handling and Swing to build GUI application).</p> <p>1) Write a Java program to implement Swing components namely Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars to design interactive GUI.</p> <p>2) Write a program to create a window with four text fields for the name, street, city and pincode with suitable labels. Also windows contains a button MyInfo. When the user types the name, his street, city and pincode and then clicks the button, the types details must appear in Arial Font with Size 32, Italics.</p> <p>3) Write a Java program to create a simple calculator using java AWT elements. .Use a grid layout to arrange buttons for the digits and basic operation +, -, /, *. Add a text felid to display the results.</p> <p>4) Write a Java Program to create a Student Profile form using AWT controls.</p> <p>5) Write a Java Program to simulate traffic signal light using AWT and Swing Components.</p>	12	LO1 LO4 LO5

		<p>6) Write a Java Program to create a color palette. Declare a grid of Buttons to set the color names. Change the background color by clicking on the color button.</p> <p>7) Build a GUI program that allows the user to add objects to a collection and perform search and sort on that collection.(Hint. Use Swing components like JButton, JList, JFrame, JPanel and JOptionPane.)</p>		
VI	GUI Programming-II (JavaFX)	<p>JavaFX Basic Concepts, JavaFX application skeleton, Compiling and running JavaFX program, Simple JavaFX control: Label, Using Buttons and events, Drawing directly on Canvas. (Perform any one program that contains the concept of JavaFX).</p> <p>1) Write a Java program to design a Login Form using JavaFX Controls. 2) Write Java program to draw various shapes on Canvas using JavaFX.</p>	04	LO1 LO5 LO6

Text Books:

1. Herbert Schildt, “Java-The Complete Reference”, Tenth Edition, Oracle Press, Tata McGraw Hill Education.
2. E. Balguruswamy, “Programming with Java A primer”, Fifth edition, Tata McGraw Hill Publication
3. Anita Seth, B.L. Juneja, “Java One Step Ahead”, oxford university press.

References:

1. D.T. Editorial Services, “Java 8 Programming Black Book”, Dreamtech Press.
2. Learn to Master Java by Star EDU Solutions
3. Yashvant Kanetkar, “Let Us Java” ,4th Edition ,BPB Publications.

Term Work:

The Term work shall consist of at least 15 practical based on the above list. The term work Journal must include at least 2 Programming assignments. The Programming assignments should be based on real world applications which cover concepts from more than one modules of syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	--	--	--	25	25	50

Course Objectives

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.

Course Outcome: 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. Analyse 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 life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- 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.
- 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.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- 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.
- 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.

Guidelines for Assessment of Mini Project:

Term Work

- 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.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- 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.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- 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.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
 - Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.
-

Assessment criteria of Mini Project.

Mini Project 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 **one year, project**, 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 **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- 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 organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project 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
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**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 ^{\$}	--	--	2	--	2	
Total		15	14	1	15	7	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
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
Total		--	--	100	400	--	150	75	775

\$ indicates work load of Learner (Not Faculty), for Mini Project. 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	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC401	Engineering Mathematics-IV	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme								
		Theory				End Sem Exam	Term Work	Pract	Oral	Total
		Internal Assessment			Avg of Test 1 & 2					
		Test1	Test2							
ITC401	Engineering Mathematics-IV	20	20	20	80	25	-	-	125	

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

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To study Matrix algebra and its application in engineering problems.
2	To learn Line and Contour integrals and expansion of complex valued function in a power series.
3	To study Z-Transforms and Inverse Z-Transforms with its properties.
4	To acquaint with the concepts of probability distributions and sampling theory for small samples.
5	To study and apply Linear and Non-linear programming Techniques to solve the optimization problems

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Apply the concepts of eigen values and eigen vectors to solve engineering problems.	L1, L2, L3
2	Illustrate the use of concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.	L3
3	Apply the concept of Z- transformation and its inverse in engineering problems.	L1,L2,L3

4	Apply the concept of probability distribution to engineering problems & testing hypothesis of small samples using sampling theory.	L3
5	Apply the concept of Linear Programming to solve the optimization problems	L1, L2, L3
6	Use the Non-Linear Programming techniques to solve the optimization problems.	L3

Module	Detailed Contents	Hours	CO Mapping
01	<p>Module: Linear Algebra (Theory of Matrices)</p> <p>1.1 Characteristic Equation, Eigenvalues and Eigenvectors and properties (without proof)</p> <p>1.2 Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials</p> <p>1.3 Similarity of matrices, diagonalizable and non-diagonalizable matrices</p> <p>Self-learning Topics: Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.</p>	7	CO1
02	<p>Module: Complex Integration</p> <p>2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).</p> <p>2.2 Taylor's and Laurent's series (without proof).</p> <p>2.3 Definition of Singularity, Zeroes, poles of $f(z)$, Residues, Cauchy's Residue Theorem (without proof)</p> <p>Self-learning Topics: Application of Residue Theorem to evaluate real integrations.</p>	7	CO2
03	<p>Module: Z Transform</p> <p>3.1 Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}$, $\{a^{ k }\}$, $\{{}^{k+n}_n C \cdot a^k\}$, $\{c^k \sin(\alpha k + \beta)\}$, $\{c^k \sinh \alpha k\}$, $\{c^k \cosh \alpha k\}$.</p> <p>3.2 Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem.</p> <p>3.3 Inverse Z transform: Partial Fraction Method, Convolution Method.</p> <p>Self-learning Topics: Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion</p>	5	CO3
04	<p>Module: Probability Distribution and Sampling Theory</p> <p>4.1 Probability Distribution: Poisson and Normal distribution</p> <p>4.2 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.</p> <p>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.</p> <p>Self-learning Topics: Test significance for Large samples, Estimate parameters of a population., Yate's Correction.</p>	7	CO4
05	Module: Linear Programming Problems	6	

	<p>5.1 Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.</p> <p>5.2 Artificial variables, Big-M method (Method of penalty)</p> <p>5.3 Duality, Dual of LPP and Dual Simplex Method</p> <p>Self-learning Topics: Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method</p>		CO5
06	<p>Module: Nonlinear Programming Problems</p> <p>6.1 NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers</p> <p>6.2 NLPP with two equality constraints</p> <p>6.3 NLPP with inequality constraint: Kuhn-Tucker conditions</p> <p>Self-learning Topics: Problems with two inequality constraints, Unconstrained optimization: One dimensional search method (Golden Search method, Newton's method). Gradient Search method</p>	7	CO6

References:

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

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. 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 should be considered as mini project in Engineering Mathematics. This project should be graded for 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:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
 2. Total 04 questions need to be solved.
 3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
 4. Remaining questions will be randomly selected from all the modules.
 5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC402	Computer Network and Network Design	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC402	Computer Network and Network Design	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Understand the division of network functionalities into layers.
2	Understand the types of transmission media along with data link layer concepts, design issues and protocols
3	Analyze the strength and weaknesses of routing protocols and gain knowledge about IP addressing
4	Understand the data transportation, issues and related protocols for end to end delivery of data.
5	Understand the data presentation techniques used in presentation layer & client/server model in application layer protocols.
6	Design a network for an organization using networking concepts

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the functionalities of each layer of the models and compare the Models.	L1
2	Categorize the types of transmission media and explain data link layer concepts, design issues and protocols.	L2, L3, L4
3	Analyze the routing protocols and assign IP address to networks.	L4
4	Explain the data transportation and session management issues and related protocols used for end to end delivery of data.	L1, L2
5	List the data presentation techniques and illustrate the client/server model in application layer protocols.	L1, L3
6	Use of networking concepts of IP address, Routing, and application services to design a network for an organization	L3

Prerequisite: PCOM

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Terminologies of communication	02	-
I	Introduction to Computer Networks	Uses Of Computer Networks, Network Hardware, Network Software, Protocol Layering, Reference Models: OSI, TCP/IP, Comparison of OSI & TCP/IP, Network Devices. Self-learning Topics: Identify the different devices used in Network connection. College campus	03	CO1
II	Physical Layer & Data Link Layer	Physical layer: Guided Media, Unguided Media, Wireless Transmission: Electromagnetic Spectrum. Switching: Circuit-Switched Networks, Packet Switching, Structure Of A Switch DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction(Hamming Code,Parity, CRC, Checksum) , Elementary Data Link protocols : Stop and Wait, Sliding Window(Go Back N, Selective Repeat), Piggybacking, HDLC Medium Access Protocols: Random Access, Controlled Access, Channelization. Ethernet Protocol: Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, 10-Gigabit Ethernet. Self-learning Topics: Differentiate link layer in IOT network and Normal Network.	08	CO2
III	Network Layer	Network Layer Services, Packet Switching, Network Layer Performance, IPv4 Addressing (classful and classless), Subnetting, Supernetting ,IPv4 Protocol, DHCP, Network Address Translation (NAT). Routing algorithms: Distance Vector Routing, Link state routing,Path Vector Routing. Protocols –RIP,OSPF,BGP. Next Generation IP: IPv6 Addressing,IPv6 Protocol, Transition fromIPV4 to IPV6 Self-learning Topics: Study difference between IPV4 and IPV6. Network Class A, B, C, D, E and subnet mask.	08	CO3

IV	Transport Layer & Session Layer	<p>Transport Layer: Transport Layer Services, Connectionless & Connection-oriented Protocols, Transport Layer protocols: User Datagram Protocol: UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers.</p> <p>Session Layer: Session layer design issues, Session Layer protocol - Remote Procedure Call (RPC),</p> <p>Self-learning Topics: List real time example of UDP and TCP.</p>	07	CO4
V	Presentation Layer & Application Layer	<p>Presentation layer :Compression: Comparison between Lossy Compression and Lossless Compression, Huffman Coding, Speech Compression, LZW, RLE, Image Compression – GIF,JPEG.</p> <p>Application layer: Standard Client-Server Protocols: World Wide Web, HTTP, FTP, Electronic Mail, Domain Name System (DNS), SNMP</p> <p>Self-learning Topics: Difference between HTTP and FTP Protocol.</p>	05	CO5
VI	Network Design Concepts	<p>Introduction to VLAN ,VPN</p> <p>A case study to design a network for an organization meeting the following guidelines:</p> <p>Networking Devices, IP addressing: Subnetting, Supernetting, Routing Protocols to be used, Services to be used: TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.</p> <p>Self-learning Topics: Study the Network Design of your college campus.</p>	06	CO6

Text Books:

1. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education.
2. Behrouz A. Forouzan, Data Communications and Networking ,4th Edition,Mc Graw Hill education.

References:

1. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
- 2.B. A. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill edition, Third Edition.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGrawHill , Second Edition.
4. Khalid Sayood, Introduction to Data Compression, Third Edition, Morgan Kaufman.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC403	Operating System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC403	Operating System	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To understand the major components of Operating System & its functions.
2	To introduce the concept of a process and its management like transition, scheduling, etc.
3	To understand basic concepts related to Inter-process Communication (IPC) like mutual exclusion, deadlock, etc. and role of an Operating System in IPC.
4	To understand the concepts and implementation of memory management policies and virtual memory.
5	To understand functions of Operating System for storage management and device management.
6	To study the need and fundamentals of special-purpose operating system with the advent of new emerging technologies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand the basic concepts related to Operating System.	L1, L2
2	Describe the process management policies and illustrate scheduling of processes by CPU.	L1
3	Explain and apply synchronization primitives and evaluate deadlock conditions as handled by Operating System.	L2
4	Describe and analyze the memory allocation and management functions of Operating System.	L1
5	Analyze and evaluate the services provided by Operating System for storage management.	L4, L5
6	Compare the functions of various special-purpose Operating Systems.	L2

Prerequisite: Programming Language C

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Programming Language C; Basic of Hardware i.e. ALU, RAM, ROM, HDD, etc.; Computer-System Organization.	02	-
I	Fundamentals of Operating System	<p>Introduction to Operating Systems; Operating System Structure and Operations; Functions of Operating Systems; Operating System Services and Interface; System Calls and its Types; System Programs; Operating System Structure; System Boot.</p> <p>Self-learning Topics: Study of any three different OS. System calls with examples for different OS.</p>	03	CO1
II	Process Management	<p>Basic Concepts of Process; Operation on Process; Process State Model and Transition; Process Control Block; Context Switching; Introduction to Threads; Types of Threads, Thread Models; Basic Concepts of Scheduling; Types of Schedulers; Scheduling Criteria; Scheduling Algorithms.</p> <p>Self-learning Topics: Performance comparison of Scheduling Algorithms, Selection of Scheduling Algorithms for different situations, Real-time Scheduling</p>	06	CO2
III	Process Coordination	<p>Basic Concepts of Inter-process Communication and Synchronization; Race Condition; Critical Region and Problem; Peterson's Solution; Synchronization Hardware and Semaphores; Classic Problems of Synchronization; Message Passing; Introduction to Deadlocks; System Model, Deadlock Characterization; Deadlock Detection and Recovery; Deadlock Prevention; Deadlock Avoidance.</p> <p>Self-learning Topics: Study a real time case study for Deadlock detection and recovery.</p>	09	CO3
IV	Memory Management	<p>Basic Concepts of Memory Management; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation; Basic Concepts of Virtual Memory; Demand Paging, Copy-on Write; Page Replacement Algorithms; Thrashing.</p> <p>Self-learning Topics: Memory Management for any one Operating System, Implementation of Page Replacement Algorithms.</p>	09	CO4

V	Storage Management	Basic Concepts of File System; File Access Methods; Directory Structure; File-System Implementation; Allocation Methods; Free Space Management; Overview of Mass-Storage Structure; Disk Structure; Disk Scheduling; RAID Structure; Introduction to I/O Systems. Self-learning Topics: File System for Linux and Windows, Features of I/O facility for different OS.	06	CO5
VI	Special-purpose Operating Systems	Open-source and Proprietary Operating System; Fundamentals of Distributed Operating System; Network Operating System; Embedded Operating Systems; Cloud and IoT Operating Systems; Real-Time Operating System; Mobile Operating System; Multimedia Operating System; Comparison between Functions of various Special-purpose Operating Systems. Self-learning Topics: Case Study on any one Special-purpose Operating Systems.	04	CO6

Text Books:

1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2. W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3. A. Tanenbaum, Modern Operating Systems, Pearson, 4th ed., 2015.

Reference Books:

1. N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
2. A. Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson.
3. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform, 1st ed., 2018.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC404	Automata Theory	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC404	Automata Theory	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To learn fundamentals of Regular and Context Free Grammars and Languages.
2	To understand the relation between Regular Language and Finite Automata and machines.
3	To learn how to design Automata's as Acceptors, Verifiers and Translators.
4	To understand the relation between Regular Languages, Contexts free Languages, PDA and TM.
5	To learn how to design PDA as acceptor and TM as Calculators.
6	To learn applications of Automata Theory.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Explain, analyze and design Regular languages, Expression and Grammars.	L2, L4, L6
2	Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator.	L6
3	Analyze and design Context Free languages and Grammars.	L4, L6
4	Design different types of Push down Automata as Simple Parser.	L6
5	Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine.	L6
6	Develop understanding of applications of various Automata.	L6

Prerequisite: Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
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0	Prerequisite	Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.	02	-
I	Introduction and Regular Languages	Languages: Alphabets and Strings. Regular Languages: Regular Expressions, Regular Languages, Regular Grammars, RL and LL grammars, Closure properties Self-learning Topics: Practice exercise on Regular Expressions. Identify the tools also.	05	CO1
II	Finite Automata	Finite Automata: FA as language acceptor or verifier, NFA (with and without ϵ), DFA, RE to NFA, NFA to DFA, Reduced DFA , NFA-DFA equivalence, FA to RE. Finite State Machines with output : Moore and Mealy machines. Moore and Mealy M/C conversion. Limitations of FA. Self-learning Topics: Practice exercise on FA and NFA	09	CO2
III	Context Free Grammars	Context Free Languages: CFG, Leftmost and Rightmost derivations, Ambiguity, Simplification and Normalization (CNF & GNF) and Chomsky Hierarchy (Types 0 to 3) Self-learning Topics: Practice numerical or exercise on CFG	08	CO3
IV	Push Down Automata	Push Down Automata: Deterministic (single stack) PDA, Equivalence between PDA and CFG. Power and Limitations of PDA. Self-learning Topics: List the examples of PDA.	05	CO4
V	Turing Machine	Turing Machine: Deterministic TM, Variants of TM, Halting problem, Power of TM. Self-learning Topics: Practice numerical of TM.	07	CO5
VI	Applications of Automata	Applications of FA, CFG, PDA & TM. Introduction to Compiler & Its phases. Self-learning Topics: Case study on any one compiler.	03	CO2,CO3, CO4,CO5, CO6

Text books

1. J.C.Martin, "Introduction to languages and the Theory of Computation", TMH.
2. Kavi Mahesh, "Theory of Computation A Problem Solving Approach", Wiley India
3. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman , "Compilers Principles, Techniques and Tools", Pearson Education.

References

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. Daniel I.A. Cohen, "Introduction to Computer Theory", John Wiley & Sons.
3. Vivek Kulkarni," Theory of Computation", Oxford University.
4. N.Chandrashekhar, K.L.P. Mishra, "Theory of Computer Science, Automata Languages & Computations", PHI publications.
- 5.J. J. Donovan, " Systems Programming", TMH.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://online.stanford.edu
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
 - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of **four questions** need to be answered
-

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC405	Computer Organization and Architecture	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC405	Computer Organization and Architecture	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Learn the fundamentals of Digital Logic Design.
2	Conceptualize the basics of organizational and features of a digital computer.
3	Study microprocessor architecture and assembly language programming.
4	Study processor organization and parameters influencing performance of a processor.
5	Analyse various algorithms used for arithmetic operations.
6	Study the function of each element of memory hierarchy and various data transfer techniques used in digital computer.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate the fundamentals of Digital Logic Design	L1, L2
2	Describe basic organization of computer, the architecture of 8086 microprocessor and implement assembly language programming for 8086 microprocessors.	L1
3	Demonstrate control unit operations and conceptualize instruction level parallelism.	L1, L2
4	List and Identify integers and real numbers and perform computer arithmetic operations on integers.	L1,L4
5	Categorize memory organization and explain the function of each element of a memory hierarchy.	L4
6	Examine different methods for computer I/O mechanism.	L3

Prerequisite: Basics of Electrical Engineering, Fundamentals of Computer.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of Electrical Engineering, Fundamentals of Computer	02	
I	Fundamentals of Logic Design	<p>Number systems: Introduction to Number systems, Binary Number systems, Signed Binary Numbers, Binary, Octal, Decimal and Hexadecimal number and their conversions, 1's and 2's complement</p> <p>Combinational Circuits: NOT,AND,OR,NAND,NOR,EX-OR,EX-NOR Gates. Half & Full Adder and subtractor, Reduction of Boolean functions using K-map method (2,3,4 Variable), introduction to Multiplexers and Demultiplexers, Encoders & Decoders.</p> <p>Sequential Circuits: Introduction to Flip Flops: SR, JK, D, T, master slave flip flop, Truth Table.</p> <p>Self-learning Topics: Number System, Quine-McCluskey, Flip-Flop conversion, Counter Design.</p>	07	CO1
II	Overview of Computer Architecture & Organization	<p>Introduction of Computer Organization and Architecture. Basic organization of computer and block level description of the functional units. Evolution of Computers, Von Neumann model. Performance measure of Computer Architecture, Amdahl's Law Architecture of 8086 Family, Instruction Set, Addressing Modes, Assembler Directives, Mixed-Language Programming, Stack, Procedure, Macro.</p> <p>Self-learning Topics: Interfacing of I/O devices with 8086(8255,ADC,DAC).</p>	08	CO2
III	Processor Organization and Architecture	<p>CPU Architecture, Instruction formats, basic instruction cycle with Interrupt processing. Instruction interpretation and sequencing. Control Unit: Soft wired (Microprogrammed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations, concepts of nano programming. Introduction to parallel processing concepts, Flynn's classifications, instruction pipelining, pipeline hazards.</p> <p>Self-learning Topics: Study the examples on instruction pipelining for practice.</p>	07	CO3
IV	Data Representation and Arithmetic Algorithms	<p>Booth's algorithm. Division of integers: Restoring and non-restoring division, signed division, basics of floating-point representation IEEE 754 floating point (Single & double precision) number representation.</p> <p>Self-learning Topics: Implement Booth's Algorithm and Division methods.</p>	04	CO4
V	Memory Organization	<p>Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics. Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory</p>	07	CO5

		Self-learning Topics: Case study on Memory Organization, Numerical on finding EAT, Address mapping.		
VI	I/O Organization	Input/output systems, I/O module-need & functions and Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA Self-learning Topics: Comparison of all I/O methods.	04	CO6

Text Books:

1. R. P. Jain, "Modern Digital Electronics", TMH
2. M. Morris Mano, "Digital Logic and Computer Design", PHI
3. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, Fifth Edition, Tata McGraw-Hill.
4. William Stallings, Computer Organization and Architecture: Designing for Performance, Eighth Edition, Pearson
5. John Uffenbeck, 8086/8088 family: Design Programming and Interfacing, (Pearson Education

References:

1. A. Anand Kumar, "Fundamentals of Digital Circuits", PHI
2. Donald P Leach, Albert Paul Malvino, "Digital Principles & Applications", TMH.
3. B. Govindarajulu, Computer Architecture and Organization: Design Principles and Applications, Computer Architecture and Organization: Design Principles and Applications, Tata McGraw-Hill
4. Dr. M. Usha, T. S. Srikanth, Computer System Architecture and Organization, First Edition, Wiley-India.
5. John P. Hayes, Computer Architecture and Organization, Third Edition, McGraw-Hill
6. K Bhurchandi, Advanced Microprocessors & Peripherals, Tata McGraw-Hill Education

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.geeksforgeeks.org
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL401	Network Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL401	Network Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To get familiar with the basic network administration commands
2	To install and configure network simulator and learn basics of TCL scripting.
3	To understand the network simulator environment and visualize a network topology and observe its performance
4	To implement client-server socket programs.
5	To observe and study the traffic flow and the contents of protocol frames.
6	To design and configure a network for an organization

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Execute and evaluate network administration commands and demonstrate their use in different network scenarios	L3, L5
2	Demonstrate the installation and configuration of network simulator.	L1, L2
3	Demonstrate and measure different network scenarios and their performance behavior.	L1, L2
4	Implement the socket programming for client server architecture.	L3
5	Analyze the traffic flow of different protocols	L4
6	Design a network for an organization using a network design tool	L6

Prerequisite: C /Java

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: NS2.34, Protocol Analyzer (eg. Wireshark), C/Java/python
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DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Programming Language (C/Java), Basic commands of windows and Unix/Linux operating system. editor commands (eg nano/vi editor etc)	02	-
I	Fundamentals of Computer Network	Understanding Basic networking Commands: ifconfig ,ip, traceroute, tracepath, ping, netstat, ss, dig, nslookup, route, host, arp, hostname, curl or wget, mtr, whois, tcpdump <ul style="list-style-type: none"> Execute and analyze basic networking commands. 	02	LO1
II	Basics of Network simulation	Installation and configuration of NS2. Introduction to Tcl Hello Programming <ul style="list-style-type: none"> Installation and configuring of NS-2 simulator and introduction to Tcl using Hello program 	02	LO2
III	Simulation of Network Topology with different Protocols	Implementation of Specific Network topology with respect to <ol style="list-style-type: none"> Number of nodes and physical layer configuration Graphical simulation of network with Routing Protocols (Distance Vector/ Link State Routing) and traffic consideration (TCP, UDP) using NAM. Analysis of network performance for quality of service parameters such as packet-delivery-ratio, delay and throughput Comparative analysis of routing protocols with respect to QOS parameters using Xgraph/gnuplot for different load conditions. <ul style="list-style-type: none"> Write TCL scripts to create topologies. Create and run traffics and analyze the result using NS2 Write TCL scripts for topology with Graphical simulation of traffic consideration (TCP, UDP) using NAM and plot the graph Implement distance vector and link state routing protocols in NS2. 	06	LO3 LO5
IV	Socket Programming	Socket Programming with C/Java/python <ol style="list-style-type: none"> TCP Client, TCP Server UDP Client, UDP Server <ul style="list-style-type: none"> To study and Implement Socket Programming using TCP. 	04	LO4

		<ul style="list-style-type: none"> To study and Implement Socket Programming using UDP 		
V	Protocol Analyzer	<ol style="list-style-type: none"> Study of various Network Protocol Analyzer Tools like Wireshark, tcpdump, Windump, Microsoft Message Analyzer, Ettercap, Nirsoft SmartSniff etc. Install one of the Network protocol analyzer tools and analyze the traffic <ul style="list-style-type: none"> Study various network protocol analyzer tools and analyze the network traffics using one of the network protocol analyzer tools. 	04	LO5
VI	Network Design	<p>Network Design for an organization using the following concepts:</p> <ol style="list-style-type: none"> Addressing (IP Address Assignment), Naming (DNS) Routing <ul style="list-style-type: none"> Perform remote login using Telnet Server Design a network for an organization using the concepts of Addressing (IP Address Assignment), Naming (DNS) and Routing. Also mention the internetworking devices used 	06	LO6

Text Books:

- Computer Network Simulation in NS2 Basic Concepts and Protocol Implementation.-Prof Neeraj Bhargava, Pramod Singh Rathore, Dr. Ritu Bhargava, Dr. Abhishek Kumar, First Edition. BPB Publication.
- Packet analysis with Wire shark, Anish Nath, PACKT publishing
- TCP/IP Protocol Suite 4th Edition by Behrouz A. Forouzan

References:

- NS2.34 Manual
- Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems by Chris Sanders

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL402	Unix Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL402	Unix Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To understand architecture and installation of Unix Operating System
2	To learn Unix general purpose commands and programming in Unix editor environment
3	To understand file system management and user management commands in Unix.
4	To understand process management and memory management commands in Unix
5	To learn basic shell scripting.
6	To learn scripting using awk and perl languages.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand the architecture and functioning of Unix	L1, L2
2	Identify the Unix general purpose commands	L4
3	Apply Unix commands for system administrative tasks such as file system management and user management.	L3
4	Execute Unix commands for system administrative tasks such as process management and memory management	L4
5	Implement basic shell scripts for different applications.	L3
6	Implement advanced scripts using awk & perl languages and grep, sed, etc. commands for performing various tasks.	L3

Prerequisite: Programming Language C

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: Unix, Editor, Bash shell, Bourne shell and C shell
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DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic Programming Skills, Concepts of Operating System	02	-
I	Introduction to Unix	Case Study: Brief History of UNIX, Unix Architecture; Installation of Unix Operating System	03	LO1
II	Basic Commands	a) Execution of Unix General Purpose Utility Commands like echo, clear, exit, date, time, uptime, cal, cat, tty, man, which, history, id, pwd, whoami, ping, ifconfig, pr, lp, lpr, lpstat, lpq, lprm, cancel, mail, etc. b) Working with Editor Vi/other editor.	03	LO2
III	Commands for File System Management and User Management	a) Study of Unix file system (tree structure), file and directory permissions, single and multiuser environment. b) Execution of File System Management Commands like ls, cd, pwd, cat, mkdir, rmdir, rm, cp, mv, chmod, wc, piping and redirection, grep, tr, echo, sort, head, tail, diff, comm, less, more, file, type, wc, split, cmp, tar, find, vim, gzip, bzip2, unzip, locate, etc. c) Execution of User Management Commands like who, whoami, su, sudo, login, logout, exit, passwd, useradd/adduser, usermod, userdel, groupadd, groupmod, groupdel, gpasswd, chown, chage, chgrp, chfn, etc.	04	LO3
IV	Commands for Process Management and Memory Management	a) Execution of Process Management Commands like ps, pstree, nice, kill, pkill, killall, xkill, fg, bg, pgrep, renice, etc. b) Execution of Memory Management Commands like free, /proc/meminfo, top, htop, df, du, vmstat, demidecode, sar, pagesize, etc.	04	LO4
V	Basic Scripts	a) Study of Shell, Types of Shell, Variables and Operators b) Execute the following Scripts (at least 6): (i) Write a shell script to perform arithmetic operations. (ii) Write a shell script to calculate simple interest. (iii) Write a shell script to determine largest among three integer numbers. (iv) Write a shell script to determine a given year is leap year or not. (v) Write a shell script to print multiplication table of given number using while statement.	04	L02, L03, L05

		<p>(vi) Write a shell script to search whether element is present is in the list or not.</p> <p>(vii) Write a shell script to compare two strings.</p> <p>(viii) Write a shell script to read and check if the directory / file exists or not, if not make the directory / file.</p> <p>(ix) Write a shell script to implement menu-driven calculator using case statement.</p> <p>(x) Write a shell script to print following pattern: * * * * * * * * * *</p> <p>(xi) Write a shell script to perform operations on directory like: display name of current directory; display list of directory contents; create another directory, write contents on that and copy it to a suitable location in your home directory; etc.</p>		
VI	Advanced Scripts	<p>a) Execute the following scripts using grep / sed commands:</p> <p>(i) Write a script using grep command to find the number of words character, words and lines in a file.</p> <p>(ii) Write a script using egrep command to display list of specific type of files in the directory.</p> <p>(iii) Write a script using sed command to replace all occurrences of particular word in given a file.</p> <p>(iv) Write a script using sed command to print duplicated lines in input.</p> <p>b) Execute the following scripts using awk / perl languages:</p> <p>(i) Write an awk script to print all even numbers in a given range.</p> <p>(ii) Write an awk script to develop a Fibonacci series (take user input for number of terms).</p> <p>(iii) Write a perl script to sort elements of an array.</p> <p>(iv) Write a perl script to check a number is prime or not.</p>	06	LO2, L03, L06

Text Books:

1. S. Das, Unix Concepts and Applications, 4th ed., McGraw Hill, 2017.
2. R. Michael, Mastering Unix Shell Scripting, 2nd ed., Wiley, 2008.
3. D. Ambawade, D. Shah, Linux Labs and Open Source Technologies, Dreamtech Press, 2014.

References:

1. Y. Kanetkar, Unix Shell Programming, BPB Publications, 2003.
2. B. Forouzan and R. Gilberg, Unix and Shell Programming, Cengage Learning, 2003.

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL403	Microprocessor Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL403	Microprocessor Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	Learn assembling and disassembling of PC
2	Design, simulate and implement different digital circuits
3	Get hands on experience with Assembly Language Programming.
4	Study interfacing of peripheral devices with 8086 microprocessor.
5	Realize techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.
6	Write and debug programs in TASM/MASM/hardware kits

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Demonstrate various components and peripheral of computer system	L2
2	Analyze and design combinational circuits	L4, L6
3	Build a program on a microprocessor using arithmetic & logical instruction set of 8086.	L3
4	Develop the assembly level programming using 8086 loop instruction set	L6
5	Write programs based on string and procedure for 8086 microprocessor.	L1
6	Design interfacing of peripheral devices with 8086 microprocessor.	L6

Prerequisite: Logic Design, Programming Languages(C, C++)

Hardware & Software Requirements:

NOTE: Programs can be executed on assembler or hardware boards.

Hardware Requirement:	Software requirement:
<ul style="list-style-type: none">➤ Motherboard, RAM, Processor, Connectors, Cables, SMPS, HDD, Monitor, Graphics card (optional), and Cabinet.➤ 8086 microprocessor experiment kits with specified interfacing study boards	<ul style="list-style-type: none">➤ Microsoft Macro Assembler (TASM)/Turbo Assembler (TASM)➤ Virtual simulator lab.➤ Proteus design suite

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	PC Assembly	Study of PC Motherboard Technology (South Bridge and North Bridge), Internal Components and Connections used in computer system.	02	LO1
II	Implementation of combinational circuits	<ol style="list-style-type: none">1. Verify the truth table of various logic gates (basic and universal gates)2. Realize Half adder and Full adder3. Implementation of MUX and DeMUX	06	LO2
III	Arithmetic and logical operations in 8086 Assembly language programming	<ol style="list-style-type: none">1. Program for 16 bit BCD addition2. Program to evaluate given logical expression.3. Convert two digit Packed BCD to Unpacked BCD. (any two)	05	LO3
IV	Loop operations in 8086 Assembly language programming	<ol style="list-style-type: none">1. Program to move set of numbers from one memory block to another.2. Program to count number of 1's and 0's in a given 8 bit number3. Program to find even and odd numbers from a given list4. Program to search for a given number (any three)	06	LO4
V	String & Procedure in 8086 Assembly language programming	<ol style="list-style-type: none">1. Check whether a given string is a palindrome or not.2. Compute the factorial of a positive integer 'n' using procedure. OR Generate the first 'n' Fibonacci numbers.	04	LO5
VI	Interfacing with 8086 microprocessor	<ol style="list-style-type: none">1. Interfacing Seven Segment Display2. Interfacing keyboard matrix3. Interfacing DAC (any one)	03	LO6

Text Books:

1. Scott Mueller, "Upgrading and repairing PCs", Pearson,
2. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.
3. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing:"Pearson Education

Reference Books:

1. M. Morris Mano, "Digital Logic and computer Design", PHI
2. K Bhurchandi, "Advanced Microprocessors & Peripherals", Tata McGraw-Hill Education

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL404	Python Lab (SBL)	--	04	--	--	02	--	02

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL404	Python Lab (SBL)	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	Basics of python including data types, operator, conditional statements, looping statements, input and output functions in Python
2	List, tuple, set, dictionary, string, array and functions
3	Object Oriented Programming concepts in python
4	Concepts of modules, packages, multithreading and exception handling
5	File handling, GUI & database programming
6	Data visualization using Matplotlib, Data analysis using Pandas and Web programming using Flask

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand the structure, syntax, and semantics of the Python language.	L1, L2
2	Interpret advanced data types and functions in python	L1, L2
3	illustrate the concepts of object-oriented programming as used in Python	L2
4	Create Python applications using modules, packages, multithreading and exception handling.	L6
5	Gain proficiency in writing File Handling programs ,also create GUI applications and evaluate database operations in python.	L1, L2
6	Design and Develop cost-effective robust applications using the latest Python trends and technologies	L6

Prerequisite: Structured Programming Approach & Java Programming Lab

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Dual core Processor or higher 2. Minimum 2 GB RAM 3. Minimum 40 GB Hard disk 4. Network interface card	1. Windows or Linux Desktop OS 2. Python 3.6 or higher 3. Notepad ++ 4. Python IDEs like IDLE, Pycharm, Pydev, Netbeans or Eclipse 5. Mysql	1. Internet Connection for installing additional packages if required

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Python IDE installation and environment setup.	02	
I	Basics of Python	Introduction, Features, Python building blocks – Identifiers, Keywords, Indention, Variables and Comments, Basic data types (Numeric, Boolean, Compound) Operators: Arithmetic, comparison, relational, assignment, logical, bitwise, membership, identity operators, operator precedence Control flow statements: Conditional statements (if, if...else, nested if) Looping in Python (while loop, for loop, nested loops) Loop manipulation using continue, pass, break. Input/output Functions, Decorators, Iterators and Generators.	08	LO 1
II	Advanced data types & Functions	Lists: a) Defining lists, accessing values in list, deleting values in list, updating lists b) Basic list operations c) Built-in list functions Tuples: a) Accessing values in Tuples, deleting values in Tuples, and updating Tuples b) Basic Tuple operations c) Built-in Tuple functions Dictionaries: a) Accessing values in Dictionary, deleting values in Dictionary, and updating Dictionary b) Basic Dictionary operations c) Built-in Dictionary functions Sets: a) Accessing values in Set, deleting values in Set, updating Sets b) Basic Set operations, c) Built-in Set functions Strings: a) String initialization, Indexing, Slicing, Concatenation, Membership & Immutability b) Built-in String functions Arrays: a) Working with Single dimensional Arrays: Creating, importing, Indexing, Slicing, copying and processing array arrays. b) Working with Multi-dimensional Arrays using Numpy: Mathematical operations, Matrix operations, aggregate and other Built-in functions	09	LO 1 LO 2

		<p>Functions: a) Built-in functions in python b) Defining function, calling function, returning values, passing parameters c) Nested and Recursive functions d) Anonymous Functions (Lambda, Map, Reduce, Filter)</p>		
III	Object Oriented Programming	<p>Overview of Object-oriented programming, Creating Classes and Objects, Self-Variable, Constructors, Inner class, Static method, Namespaces.</p> <p>Inheritance: Types of Inheritance (Single, Multiple, Multi-level, Hierarchical), Super() method, Constructors in inheritance, operator overloading, Method overloading, Method overriding, Abstract class, Abstract method, Interfaces in Python.</p>	08	LO 1 LO 3
IV	Exploring concept of modules, packages, multithreading and exception handling	<p>Modules: Writing modules, importing objects from modules, Python built-in modules (e.g. Numeric and Mathematical module, Functional Programming module, Regular Expression module), Namespace and Scoping.</p> <p>Packages: creating user defined packages and importing packages.</p> <p>Multi-threading: process vs thread, use of threads, types of threads, creating threads in python, thread synchronization, deadlock of threads.</p> <p>Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, Assert statement, User-Defined Exceptions.</p>	06	LO 1 LO 4
V	File handling, GUI & database programming	<p>File Handling: Opening file in different modes, closing a file, writing to a file, accessing file contents using standard library functions, reading from a file – read (), readline (), readlines (), Renaming and Deleting a file, File Exceptions, Pickle in Python.</p> <p>Graphical user interface (GUI): different GUI tools in python (Tkinter, PyQt, Kivy etc.), Working with containers, Canvas, Frame, Widgets (Button, Label, Text, Scrollbar, Check button, Radio button, Entry, Spinbox, Message etc.) Connecting GUI with databases to perform CRUD operations. (on supported databases like SQLite, MySQL, Oracle, PostgreSQL etc.).</p>	09	LO 1 LO 5
VI	Data visualization, analysis and web programming using python	<p>Visualization using Matplotlib: Matplotlib with Numpy, working with plots (line plot, bar graph, histogram, scatter plot, area plot, pie chart etc.), working with multiple figures.</p> <p>Data manipulation and analysis using Pandas: Introduction to Pandas, importing data into Python, series, data frames, indexing data frames, basic operations with data frame, filtering, combining and merging data frames, Removing Duplicates.</p> <p>SciPy: Linear algebra functions using Numpy and Scipy.</p> <p>Web programming: Introduction to Flask, Creating a Basic Flask Application, Build a Simple REST API using Flask</p>	10	LO 1 LO 6

List of Experiments/Mini-Project.

1)	<p>Write python programs to understand</p> <ul style="list-style-type: none"> a) Basic data types, Operators, expressions and Input Output Statements b) Control flow statements: Conditional statements (if, if...else, nested if) c) Looping in Python (while loop, for loop, nested loops) d) Decorators, Iterators and Generators.
2)	<p>Write python programs to understand</p> <ul style="list-style-type: none"> a) Different List and Tuple operations using Built-in functions b) Built-in Set and String functions c) Basic Array operations on 1-D and Multidimensional arrays using Numpy d) Implementing User defined and Anonymous Functions
3)	<p>Write python programs to understand</p> <ul style="list-style-type: none"> a) Classes, Objects, Constructors, Inner class and Static method b) Different types of Inheritance c) Polymorphism using Operator overloading, Method overloading, Method overriding, Abstract class, Abstract method and Interfaces in Python.
4)	<p>Write python programs to understand</p> <ul style="list-style-type: none"> a) Creating User-defined modules/packages and import them in a program b) Creating user defined multithreaded application with thread synchronization and deadlocks c) Creating a menu driven application which should cover all the built-in exceptions in python
5)	<p>Write python programs to understand</p> <ul style="list-style-type: none"> a) Different File Handling operations in Python b) Designing Graphical user interface (GUI) using built-in tools in python (Tkinter, PyQt, Kivy etc.). c) GUI database connectivity to perform CRUD operations in python (Use any one database like SQLite, MySQL, Oracle, PostgreSQL etc.)
6)	<p>Write python programs to implement</p> <ul style="list-style-type: none"> a) Different types of plots using Numpy and Matplotlib b) Basic operations using pandas like series, data frames, indexing, filtering, combining and merging data frames. c) Different Linear algebra functions using Scipy. d) A Basic Flask Application to build a Simple REST API.

❖ Mini Project

Mini-project have to be developed in a group of three students which should cover all above topics.

Suggested Mini-Project Topics:

1. Railway reservation system	27 IT Team Workspace	52. Business Directory	78. Practice Test Management.
2. Inventory Management system.	29 Job Requisition and Interview Management	53. Education Directory	79. Asset Management System
3 Classroom Management	28 Knowledge Base	54. Dental Clinic Management	80. Travel Agency System.
4 Clinical Trial Initiation and Management	29 Lending Library	55. Fund Raising Management	81. Placement Management System.

5 Competitive Analysis Web Site	30 Physical Asset Tracking and Management	56. Clinic/ Health Management	82. Polls Management
6 Discussion Forum website	31 Project Tracking Workspace	57. Cable Management System	83. Customer Management
7 Disputed Invoice Management	32. Shopping Cart .	58. Survey Creation and Analytics	84. Project Management System.
8 Employee Training Scheduling and Materials	33 Knowledge Base	59. Museum Management System	85. Network Marketing System
9 Equity Research Management	34 Lending Library	60. Multi-Level Marketing System	86. Yoga Health Care Management
10 Integrated Marketing Campaign Tracking	35 Physical Asset Tracking and Management	61. Learning Management System	87. Personal Finance Management System
11 Manufacturing Process Managements	36 Project Tracking Workspace	62. Knowledge Management System	88. Real Estate Management System
12 Product and Marketing Requirements Planning	37 Room and Equipment Reservations	63. Missing Person Site	89. Stock Mutual Funds Management
13 Request for Proposal Software	38 Sales Lead Pipeline	64. Disaster Management Site	90. Careers and Employment Management System
14 Sports League Management	39. Yellow Pages & Business Directory	65. Job Management Site	91. Music Albums Management System
15 Absence Request and Vacation Schedule Management	40. Time & Billing	66. Financial Portfolio Management	92. Classified Ads Managements
16 Budgeting and Tracking Multiple Projects	41. Class Room Management	67. Market Research Management	93. Property Management System
17 Bug Database Management	42. Expense Report Database	68. Order Management System	94. Sales & Retail Management
18 Call Center Management Software	43. Sales Contact Management Database	69. Point of Sale	95. Dating Site
19 Change Request Management	44. Inventory Management Database	70. Advertisement /Banner Management and Analytics	96. Hotel Management System
20 Compliance Process Support Site	45. Issue Database	71. Export Management System	97. Search Engine
21 Contacts Management Software	46. Event Management Database	72. Invoice Management	98. Online News Paper Site
22 Document Library and Review	47. Service Call Management Database	73. Recruitment Management System	99. Image Gallery
23 Event Planning and Management	48. Accounting Ledger Database	74. Articles / Blog / Wiki Web site	100. Staffing and Human Capital Management
24 Expense Reimbursement and Approval	49. Asset Tracking Database	75. Online Planner	101. Development of a feature-rich, practical Online Survey Tool (OST)
25 Help Desk and Ticket Management	50. Cycle Factory Works Management	76. Mock Tests and Examination Management	102 Development of a Web/Email based Search Engine
26 Inventory Tracking	51. Sales Corporation Management	77. Examination System	103. Development of a web-based Recruitment Process System for the HR group for a company

Text Books:

1. Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press, Wiley Publication
2. M. T. Savaliya, R. K. Maurya, "Programming through Python", StarEdu Solutions.
3. E Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Publication.

References:

1. Zed A. Shaw, "Learn Python 3 the Hard Way", Zed Shaw's Hard Way Series.
2. Martin C. Brown, "Python: The Complete Reference", McGraw-Hill Publication.
3. Paul Barry, "Head First Python", 2nd Edition, O'Reilly Media, Inc.

Online resources:

- 1) <https://docs.scipy.org/doc/numpy/user/quickstart.html>
- 2) <https://matplotlib.org/tutorials/>
- 3) https://pandas.pydata.org/docs/getting_started/
- 4) <https://www.geeksforgeeks.org/python-build-a-rest-api-using-flask/>

Term Work:

The Term work shall consist of at least 15 practical based on the above list. The term work Journal must include at least 2 Programming assignments. The Programming assignments should be based on real world applications which cover concepts from more than one modules of syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM401	Mini Project – 1 B for Python based automation projects	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM401	Mini Project – 1 B for Python based automation projects	--	--	--	--	25	25	50

Course Objectives

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 fundamentalsto attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: 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. Analyse 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 life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- 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.
- 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.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- 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.
- 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.

Guidelines for Assessment of Mini Project:

Term Work

- 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.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- 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.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- 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.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
 - Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.
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Assessment criteria of Mini Project.

Mini Project 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 **one year, project**, 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 **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- 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 organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project 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
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