University of Mumbai

No. AAMS(UG)/ 170 of 2021-22

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular Nos. UG/301 of 2008 dated 11th July, 2008, No.UG/62 of 2015 dated 27th August, 2015, UG/140 of 2015-16 dated 3rd February, 2016 and UG/96 of 2021 dated 1st April, 2021 relating to the B.E. degree course.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Computer Engineering & Civil Engineering under the Science & Technology Faculty at its meeting held on 11th May, 2021 & 22nd May, 2021 and subsequently passed by the Board of Deans at its meeting held on 11th June, 2021 vide item No.6.23 & 6.24 have been accepted by the Academic Council at its meeting held on **29th June, 2021 vide** item No. 6.23 & 6.24 and subsequently approved by the Management Council at its meeting held on **29th July, 2021 vide** item No. 16 & **27th September, 2021 vide** item No. 6 and that in accordance therewith, the amendment of **O.3701** relating to the B.E. Degree Course has been amended by incorporating **New Nine Branches for Bachelor of Engineering**, from the academic year 2021-22, accordingly. (The same is available on the University's website www.mu.ac.in) .

The Amended Ordinance 3701 :-

1. Automobile Engineering 2. Bio-medical Engineering
2. Bio-medical Engineering
3. Chemical Engineering
4. Civil Engineering
5. Computer Engineering
6. Construction Engineering
7. Electrical Engineering
8. Electronics Engineering
9. Electronics & Telecommunication Engineering
10. Instrumentation Engineering
11. Mechanical Engineering
12. Production Engineering
13. Information Technology
14. Marine Engineering
15. Bio-technology
16. Bio-informatics
17. Printing Technology

2/-

18. Mechatronics Engineering
19. Electronics & Computer Science
20.Computer Science and Engineering (Internet of Thing and Cyber Security including Block Chain Technology)
21.Artificial Intelligence & Data Science
22. Cyber Security
23.Computer Science and Engineering (Artificial Intelligence & Machine Learning)
24 Computer Science and Engineering (Data Science)
25. Internet of Thing
26. Artificial Intelligence & Machine Learning
27. Data Engineering
28. Civil and Infrastructure Engineering

MUMBAI – 400 032
26th November, 2021

(Sudhir S. Puranik)
REGISTRAR

To

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

A.C/6.23 & 6.24/29/06/2021
M.C/16/29/07/2021

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No. AAMS(UG)/ 170 -A of 2021 MUMBAI-400 032 26th November, 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 & Civil Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-ordinator, University Computerization Centre,

(Sudhir S. Puranik)
REGISTRAR

Copy to :-

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

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

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

for information.

Justifications of starting 8 new courses in the domain of Computer which are identified as emerging areas as per AICTE

1	**Necessity of starting these courses**
	Industry 4.0 demands smart systems integrated with intelligence to have a better human-machine interface. To cope up with the upcoming emerging industrial demands, the technical institutes are to be tuned to educate and train their students to meet the upcoming requirements of the industrial revolution. AICTE, in the recent past has emerged as a guiding force to guide the technical institutions of the country to transform themselves with time. These courses have widespread application in almost every industry and is a big technological shift, similar in scale to past events such as the industrial revolution, the computer age, and the smart phone revolution. These courses will give an opportunity to gain expertise in one of the most fascinating and fastest growing areas of engineering. These emerging courses will give the students a rigorous, advanced, and professional graduate-level foundation. Introduction of new courses in the emerging disciplines approved by the AICTE would help the student community in their goal of employability or entrepreneurship and this is also stated in the new National Education Policy 2020.
2	**Whether UGC has recommended to start the said courses?**
	AICTE is apex and regulatory body, which already approved these courses.
3	**Whether all the courses have commenced from the academic year 2019-20**
	Yes
4	**The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?**
	These courses are in self-financed mode. The faculty to teach courses in First, second and third year are already available in most of the institutes. The first year Engineering is common for all branches hence teachers are available in the institute to teach them in first year. By the time final year stars existing faculty will be trained to take care of final year courses.
5	**To give details regarding duration of the Course and is it possible to compress the course?**
	As per UGC and AICTE, the duration of all degree programs is 4 years. Accor dingly, the scheme is designed for 4 years duration.
6	**The intake capacity of each course and number of admissions given in the current academic year (2019-20)**
	The intake capacity of each course is 60. Most of the seats are filled in all the affiliated colleges who have started these courses,

7	**Opportunities of employability / Employment available after undertaking these courses.**
	The global labour market is increasingly adopting new technology. New technology makes it easier for companies to automate routine tasks and could disrupt the balance between job responsibilities completed by humans and those completed by machines and algorithms. Transformations and disruptions are already occurring within labour markets across the world. With smart technology becoming more mainstream, these new technologies will have great impact on our society and workforce. Over the last few years, the use of new technology has caused some job roles to disappear while also creating new, previously unheard of job titles. For example, the rise of online flight comparison sites has drastically reduced the number of physical travel agents and advancements in mobile technology has made switchboard operators obsolete. On the other hand, technological advancements in these emerging areas have also led to the emergence of brand-new job titles. The industry 4.0 revolution is largely driven by specific technological developments: high-speed mobile Internet, AI and automation, the use of big data analytics, and cloud technology. These technologies are expected to have the most significant impact on employment figures within the global workforce. A recent study released by McKinsey Global Institute reports that roughly one-fifth of the global workforce will be impacted by the adoption of AI, automation and other technologies, with the most significant impact in developed nations like the UK, German and US. By 2022, 50% of companies believe that these technologies will change the job roles and by 2030, 800 million across the world. Employees with the right skills, will take on more beneficial roles. The World Economic Forum reports that 38% businesses believe these new technologies will allow employees to carry-out new productivity-enhancing jobs while over 25% companies think automation will result in the emergence of new roles. In addition to new roles and responsibilities, the 4th Industrial Revolution could also lead to more companies employing specialist contractors or remote workers. Due to new technology and changing demands, employers may also become more supportive of existing employees wanting to work remotely or flexibility thus improving the employment opportunities.

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

Sub – Feasibility of starting new course "Civil and Infrastructure Engineering"

Reference: Letter dated 26 Dec 2019, Sub: **New Amended Ordinance (62Nos) relating introduction of various new courses in the University of Mumbai**,

(*i) Necessity of starting this new course:*

This new course "Civil and Infrastructure Engineering" is the identified as one the course in Emerging areas. AICTE has stopped giving permission to start traditional courses and started giving permission only in emerging areas.

Some of the IITs, NITs and prominent Institutes have already floated this Course at Under Graduate and Post Graduate level. Civil Infrastructure is the backbone of a nation's economy, security, and health. Civil Infrastructure Engineering addresses the robustness of the built environment. Considering the rapid growth in infrastructural activities in India and abroad, there is a need to induce this new promising branch of Engineering i.e. Civil and Infrastructure Engineering. The rapidly urbanizing society and increasing quality of life demand reliable and intelligent infrastructure systems which are capable of catering to the societal needs at different scales – from an individual to the community level. Consequently, the Civil and infrastructure industry has undergone profound changes and is constantly evolving. **However, the new-age designs and innovations in the civil and infrastructure industry can only be driven by a group of engineering graduates having multidisciplinary training and a sound understanding of emerging technologies.** In addition to this AICTE is not encouraging for conventional courses but they are encouraging to start emerging and interdisciplinary courses. One of the Institute affiliated to University of Mumbai has started this course in the Academic year 2020-21.

This program combines the core subjects of conventional civil engineering with recent technologies such as Infrastructure Planning, Modern Survey, Town and Country Planning, Water Management Infrastructure, Transport Infrastructure, Human Rights and Laws, Power and Info-Com technologies Infrastructure, Infrastructure Management & Economics. Additionally, a major thrust is also planned on the design, implementation, and maintenance of large-scale

integrated infrastructure systems across different domains. The Civil and Infrastructure Engineering program can prepare students for the employment in engineering design, planning, material, consulting and contracting firms.

(ii) Whether U.G.C. has recommended to start this new course?

AICTE is apex and regulatory body who recommends the professional courses

(iii) Whether this course "Civil and Infrastructure Engineering have commenced from the academic year 2019-20?

Yes, Civil and Infrastructure Engineering course has commenced from academic year **2020-21** at one of affiliated college of University of Mumbai.

(iv) The courses started by the University are self financed, whether adequate number of eligible permanent Faculties are available?

Yes, this course "Civil and Infrastructure Engineering" is self-financed, which is affiliated to University of Mumbai and Institute has adequate number of eligible permanent faculties required as per the norms. The first year engineering course is common for all branches of Engineering and colleges have existing faculties to teach the students in first year.

(v) Give details regarding duration of the Course and is it possible to compress the course?

This Course is of Four-Year duration consisting of 8 semesters. Considering the importance and syllabus to be covered, this Course can't be compressed.

(vi) The intake capacity of each Course and no of admissions given in the current academic year 2020-21

Intake capacity of this course at which is affiliated to University of Mumbai is 60 which is approved by AICTE. Total 08 number of students took admission in the commencing year 2020-21.

(vii) Opportunities of Employability/ Employment available after undertaking this course

India will launch a 100 trillion rupee ($1.35 trillion) national infrastructure plan that will help generate jobs. The infrastructure programme, called **"Gati Shakti"** will create job opportunities for hundreds of thousands. For “Make in India” to be successful, we need to strengthen its basic Infrastructure like roads, power, port, mining, airports, railways, oil & gas pipelines, renewable energy or social infrastructure like primary education, primary healthcare, academic institutes, water supply, waste management, vocational training, etc. such that a robust and ready platform is available for FDIs.

The alumni shall be placed in different organizations that are expertise in construction engineering, planning and management, structural and materials engineering, transportation engineering, geotechnical engineering and water and environmental engineering. Now is the opportune time for Civil and Infrastructure Engineers in India as the country is going to take leaps and bounds in implementing infrastructure projects - roads & bridges, flyovers, highways, airports, Metros, etc.

This program combines the core subjects of conventional civil engineering with multi disciplinary subjects required for Infrastructure Engineering hence equivalence as that of conventional Civil Engineering shall be considered so that graduates from this course will have opportunities to pursue higher education and to serve the nation by joining through Public Service Commission Services of Central Government and State Government.

Dr. S.K Ukarande

Chairman Board of Studies in Civil Engineering and

Associate Dean Faculty of Science and Technology

University of Mumbai.

AC: 29/6/2021
Item No: 6.23

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

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

Second Year with Effect from AY 2021-22

Under

FACULTY OF SCIENCE & TECHNOLOGY

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

AC: 29/6/2021
Item No: 6.23

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Second Year Engineering (Eight New Branches)**
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: 2021-2022**

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

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

Preamble

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

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

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

The present curriculum will be implemented for Second Year of Engineering from the academic year 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

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

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

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

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

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

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

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

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

Preface by Board of Studies in
Computer Engineering

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

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

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

The salient features of the revised syllabus are:

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

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

Board of Studies in Computer Engineering

Prof. Sunil Bhirud : Chairman

Prof. Sunita Patil : Member

Prof. Leena Raga : Member

Prof. Subhash Shinde : Member

Prof. Meera Narvekar : Member

Prof. Suprtim Biswas : Member

Prof. Sudhir Sawarkar : Member

Prof. Dayanand Ingle : Member

Prof. Satish Ket : Member

Program Structure for Second Year Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSC301	Engineering Mathematics-III	3	--	1*	3	--	1	4
CSC302	Discrete Structures and Graph Theory	3	--	--	3	--	--	3
CSC303	Data Structure	3	--	--	3	--	--	3
CSC304	Digital Logic & Computer Architecture	3	--	--	3	--	--	3
CSC305	Computer Graphics	3	--	--	3	--	--	3
CSL301	Data Structure Lab	--	2	--	--	1	--	1
CSL302	Digital Logic & Computer Architecture Lab	--	2	--	--	1	--	1
CSL303	Computer Graphics Lab	--	2	--	--	1	--	1
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	2+2*	--	--	2	--	2
CSM301	Mini Project – 1 A	--	4$	--	--	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	Test 2	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 □^□□, (□□), □□□(□□), □□□*h*(□□), □□□*h*(□□)and□^□, □ ≥ 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 1stclass 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 4sub-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	**Function**s: 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 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 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 4sub-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", 2nd 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, 2nd 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 additional40% 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, 4thEdition.
2	William Stalling, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10TH Edition.
3	John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3RD 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, 3rdEdition.
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”, 2nd 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:) 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 CSL301and 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, expect 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)

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.	

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", 8th 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	10
2	Marks awarded by review committee	10
3	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:

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. • 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. • 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, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • 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: $\{\square^{\square}\square^{\square}\}$, $\{\square^{\lvert\square\rvert}\}$, $\{^{\square+\square}\square.\ \square^{\square}\}$, $\{\square^{\square}\sin(\square\square+\square)\}$, $\{\square^{\square}\sinh\square\square\}$, $\{\square^{\square}\cosh\square\square\}$.	
	3.2	Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem.	
	3.3	Inverse Z transform: Partial Fraction Method, Convolution Method.	
	3.4	**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 1stclass 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 4sub-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 Problem0/1 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", 2nd Edition, PHI Publication 2005.
2	Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "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, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5th 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, 5th 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 processscheduling 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, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0
References:	
1	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition
2	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition.
3	Maurice J. Bach, "Design of UNIX Operating System", PHI
4	Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4th 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 thefield 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”, 8thEdition, Pearson Education India
2	Douglas Hall, “Microprocessor and Interfacing”, Tata McGraw Hill.
3	Intel Manual
4	Peter Abel, “IBM PC Assembly language and Programming”, 5th 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 : Based on the entire syllabus of CSC403: Database Management System	

Course Code	Course Name	Credit
CSL403	Operating System Lab	01

Prerequisite: Knowledge on Operating system principles	
Lab Objectives:	
1	To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.
2	To familiarize students with the architecture of Linux OS.
3	To provide necessary skills for developing and debugging programs in Linux environment.
4	To learn programmatically to implement simple operation system mechanisms
Lab Outcomes: At the end of the course, the students will be able to	
1	Demonstrate basic Operating system Commands, Shell scripts, System Calls and API wrt Linux
2	Implement various process scheduling algorithms and evaluate their performance.
3	Implement and analyze concepts of synchronization and deadlocks.
4	Implement various Memory Management techniques and evaluate their performance.
5	Implement and analyze concepts of virtual memory.
6	Demonstrate and analyze concepts of file management and I/O management techniques.

Suggested List of Experiments		
Sr. No.		**Content**
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 theses at least one experiment on hardware interfacing.
2	Journal must include at least 2 assignments on content of theory and practical of "Microprocessor"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

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

Prerequisite: Knowledge of some programming language like C, Java	
Lab Objectives:	
1	Basics of Python programming
2	Decision Making, Data structure and Functions in Python
3	Object Oriented Programming using Python
4	Web framework for developing
Lab Outcomes: At the end of the course, the students will be able to	
1	To understand basic concepts in python.
2	To explore contents of files, directories and text processing with python
3	To develop program for data structure using built in functions in python.
4	To explore django web framework for developing python-based web application.
5	To understand Multithreading concepts using python.

Module		Detailed Content	Hours
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, 3rd Edition, Zed Shaw's Hard Way Series

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	10
2	Marks awarded by review committee	10
3	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:

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. • 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. • 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, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • 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

AC- 29/06/2021
Item No. - 6.24

UNIVERSITY OF MUMBAI

Bachelor of Engineering
in
Civil & Infrastructure Engineering

Second Year with Effect from AY: 2021-22

Under

FACULTY OF SCIENCE & TECHNOLOGY

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

UNIVERSITYOFMUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Second Year B.E. Civil and Infrastructure 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	**U.G.**
7	Pattern	**Semester**
8	Status	**New**
9	To be implemented from Academic Year	**With effect from Academic Year: 2021-2022**

Date:

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

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

Preamble

In the last decade there has been rapid urbanization all over the country. It is due to constant human endeavor to strive for a more comfortable living. This is making existing infrastructure fall short to fulfil the demands of society. Accomplished infrastructure is required for the society in all its domains. Civil infrastructure consists of roads, bridges, buildings, dams, levees, water & wastewater treatment facilities, solid waste management, power generation-transmission and communications facilities.

There is a need to train engineers who have a holistic view of infrastructure and multidisciplinary knowledge background. A sound understanding of emerging and transformative technologies and functioning of the infrastructure systems is essential. Existing civil engineering program is not fully addressing this increasingly recognized need. This educational gap prompted new engineering program with more emphasis on planning, design and execution of infrastructure along with knowledge of civil engineering at undergraduate level. Accordingly AICTE proposed 'Civil and Infrastructure Engineering - a new programme at undergraduate level'. Mumbai University intends to be on the forefront with a program in 'Civil and infrastructure Engineering' which involves the design, construction and management of infrastructure.

The Faculty of science and technology resolved that to minimize the burden of contact hours, total credits of the 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 the second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed, is in line with AICTE model curriculum.

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 Internal assessment, revision, guest lectures, coverage of content beyond syllabus etc.

The curriculum will be implemented for Second Year of Civil and Infrastructure Engineering from the academic year 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

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

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

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum design is mainly focused on knowledge component, skill based activities and project based activities. Self-learning opportunities are provided to learners. In the design process of syllabus of ‘C’ scheme wherever possible, additional resource links of platforms such as NPTEL/Swayam are appropriately provided. In an earlier design 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 design 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/ Heads/ Faculty members of all the institutes 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 TechnologyUniversity of Mumbai

Dr. Anuradha Muzumdar
Dean
Faculty of Science and TechnologyUniversity of Mumbai

Preface

The engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality of education and employability of students. To meet this challenge, the issue of quality needs to be addressed and taken forward in a systematic manner. ***Accreditation*** is the principal means of quality assurance in higher education. It reflects that, in achieving recognition, the institution or program of study is committed and open to external review to meet specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program Outcomes (POs) are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education (OBE) in the process of curriculum development from Rev-2012 onwards and continued to enhance the curriculum further based on OBE in Rev-2016 and Rev-2019 "C" scheme.

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

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

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

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

Board of Studies in Civil Engineering, University of Mumbai

Dr. S. K. Ukarande	: Chairman	Dr. V. Jothiprakash	: Member
Dr. D.D. Sarode	: Member	Dr. K. K. Sangle	: Member
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Dr. Milind Waikar	: Member	Dr. A. R. Kambekar	: Member
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Program Structure for Second Year - Civil and Infrastructure Engineering

SemesterIII & IV

UNIVERSITY OF MUMBAI

(With Effect from 2021-2022)

Semester-III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CIC301	Engineering Mathematics – III	3	-	2	3	-	1	4
CIC302	Mechanics of Solids	4			4			4
CIC303	Modern Surveying	3			3			3
CIC304	Basics of Infrastructure and its planning	3	-	-	3	-	-	3
CIC305	Hydraulics	3	-	-	3	-	-	3
CIL301	Mechanics of Solids (Lab)	-	2	-	-	1	-	1
CIL302	Modern Surveying (Lab)	-	3	-	-	1.5	-	1.5
CIL303	Hydraulics (Lab)	-	2	-	-	1	-	1
CIL304	Skill Based Lab Course-I		3		-	1.5		1.5
CIM301	Mini Project– 1A	-	2	-	-	1	-	1
Total		**16**	**12**	**2**	**16**	**6**	**1**	**23**

Examination Scheme

Course Code	Course Name	Theory					Term Work	Prac. /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		Test I	Test II	Avg.					
CIC301	Engineering Mathematics – III	20	20	20	80	3	25	-	125
CIC302	Mechanics of Solids	20	20	20	80	3	-	-	100
CIC303	Modern Surveying	20	20	20	80	3	-	-	100
CIC304	Basics of Infrastructure and its planning	20	20	20	80	3	-	-	100
CIC305	Hydraulics	20	20	20	80	3	-	-	100
CIL301	Mechanics of Solids (Lab)	-	-	-	-	-	25	25	50
CIL302	Modern Surveying (Lab)	-	-	-	-	-	50	25	75
CIL303	Hydraulics (Lab)	-	-	-	-	-	25	25	50
CIL304	Skill Based Lab Course-I (CAD/ BIM)	-	-	-	-	-	50	-	50
CIM301	Mini Project– 1A	-	-	-	-	-	25	25	50
Total				**100**	**400**	**-**	**200**	**100**	**800**

Semester-IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
CIC401	Engineering Mathematics – IV	3	--	2	3	-	1	4
CIC402	Structural Analysis	4	--	-	4	-	-	4
CIC403	Town and country planning	3	--	-	3	-	-	3
CIC404	Concrete Technology, Building Materials and Construction Equipment.	3	--	-	3	-	-	3
CIC405	Geotechnics	3	-	-	3	-	-	3
CIL401	Structural Analysis (Lab)	--	2	-	-	1	-	1
CIL402	Town and country planning (Lab)	--	2	-	-	1	-	1
CIL403	Concrete Technology, Building Materials and Construction Equipment (Lab)	--	2	-	-	1	-	1
CIL404	Geotechnics (Lab)	--	2			1		1
CIL405	Skill Based lab Course–II	--	3	-	-	1.5	-	1.5
CIM401	Mini Project– 1B	--	3	-	-	1.5	-	1.5
Total		**16**	**14**	**2**	**16**	**7**	**1**	**24**

Examination Scheme

Course Code	Course Name	Theory					Term Work	Prac. /Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (hrs.)			
		Test I	Test II	Avg.					
CIC401	Engineering Mathematics – IV	20	20	20	80	3	25	-	125
CIC402	Structural Analysis	20	20	20	80	3	-	-	100
CIC403	Town and country planning	20	20	20	80	3	-	-	100
CIC404	Concrete Technology, Building Materials and Construction Equipment.	20	20	20	80	3	-	-	100
CIC405	Geotechnics	20	20	20	80	3	-	-	100
CIL401	Structural Analysis (Lab)						25	25	50
CIL402	Town and country planning (Lab)						25	25	50
CIL403	Concrete Technology, Building Materials and Construction Equipment (Lab)	-	-	-	-	-	25	25	50
CIL404	Geotechnics (Lab)	-	-	-	-	-	25	25	50
CIL405	Skill Based lab Course–II	-	-	-	-	-	50	-	50
CIM401	Mini Project– 1B	-	-	-	-	-	25	25	50
Total				**100**	**400**	**-**	**200**	**125**	**825**

Semester-V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CIC501	Transportation Infrastructure – I	3	-	-	3	-	-	3
CIC502	Foundation Engineering	3	-	-	3	-	-	3
CIC503	Design of Steel Structures	**4**	-	-	4	-	-	4
CIDO501X	Department Optional Course – I	3	-	-	3	-	-	3
CIDO502X	Department Optional Course –II	3	-	-	3	-	-	3
CIL501	Transportation Infrastructure – I (Lab)	-	2	-	-	1	-	1
CIL502	Foundation Engineering (Lab)	-	2	-	-	1	-	1
CIL503	Design of Steel structures (Lab)		2			1		1
CIL504	Skill based lab Course-III	-	3	-	-	1.5	-	1.5
CIM501	Mini Project–2A	-	3	-	-	1.5	-	1.5
Total		**16**	**12**		**16**	**6**		**22**

Examination Scheme

Course Code	Course Name	Theory					Term Work	Prac./ Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (Hrs.)			
		Test I	Test II	Avg.					
CIC501	Transportation Infrastructure – I	20	20	20	80	3	-	-	100
CIC502	Foundation Engineering	20	20	20	80	3	-	-	100
CIC503	Design of Steel structures	20	20	20	80	3	-	-	100
CIDO501X	Department Optional Course – I	20	20	20	80	3	-	-	100
CIDO502X	Department Optional Course –II	20	20	20	80	3	-	-	100
CIL501	Transportation Infrastructure – I (Lab)						25	25	50
CIL502	Foundation Engineering (Lab)						25	25	50
CIL503	Design of Steel structures (Lab)	-	-	-	-	-	25	25	50
CIL504	Skill based lab Course-III	-	-	-	-	-	50	-	50
CIM501	Mini Project–2A	-	-	-	-	-	25	25	50
Total				**100**	**400**	**-**	**150**	**100**	**750**

Semester-VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CIC601	Water Management Infrastructure	3	-		3	-	-	3
CIC602	Transport Infrastructure – II	3	-	-	3	-	-	3
CIC603	Design of RCC Structures	3	-	-	3	-	-	3
CIDO601X	Department Optional Course – III	3	-	-	3	-	-	3
CIDO602X	Department Optional Course – IV	3	-	-	3	-	-	3
CIL601	Water Management Infrastructure (Lab)	-	2	-	-	1	-	1
CIL602	Transport Infrastructure – II (Lab)	-	2	-	-	1	-	1
CIL603	Design of RCC Structures (Lab)	-	2	-	-	1	-	1
CIL604	Human rights and laws (Lab)			2			1	1
CIL605	Skill based lab Course-IV	-	3	-	-	1.5	-	1.5
CIM601	Mini Project–2B	-	3	-	-	1.5	-	1.5
Total		**15**	**12**	**02**	**15**	**6**	**01**	**22**

Examination Scheme

Course Code	Course Name	Theory					Term Work	Pract /oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		Test I	Test II	Avg.					
CIC601	Water Management Infrastructure	20	20	20	80	3	-	-	100
CIC602	Transport Infrastructure – II	20	20	20	80	3	-	-	100
CIC603	Design of RCC Structures	20	20	20	80	3	-	-	100
CIDO601X	Department Optional Course – III	20	20	20	80	3	-	-	100
CIDO602X	Department Optional Course – IV	20	20	20	80	3	-	-	100
CIL601	Water Management Infrastructure (Lab)	--	--	-	-	-	25	25	50
CIL602	Transport Infrastructure – II (Lab)						25	25	50
CIL603	Design of RCC Structures (Lab)	-	-	-	-	-	25	25	50
CIL604	Human rights and laws (Lab)	-	-	-	-	-	25	25	50
CIL605	Skill based lab Course – IV	-	-	-	-	-	50	-	50
CIM601	Mini Project–2B	-	-	-	-	-	25	25	50
Total				**100**	**400**	**-**	**175**	**125**	**800**

Semester-VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./ Tut.	Theory	Pract. Tut.	Total
CIC701	Waste Management Infrastructure	3	-	3	-	3
CIC702	Power & Info-Com technologies Infrastructure	3	-	3	-	3
CIDO701X	Department Optional Course – V	3	-	3	-	3
ILO701X	Institute Optional course – I	3	-	3	-	3
CIL701	Waste Management Infrastructure	-	2	-	1	1
CIP701	Onsite training for Infrastructure project practices (Operations and Management)	-	8	-	4	4
CIP702	Major Project-I	-	6	-	3	3
Total		**12**	**16**	**12**	**8**	**20**

Examination Scheme

Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (Hrs.)			
		Test I	Test II	Avg.					
CIC701	Waste Management Infrastructure	20	20	20	80	3		-	100
CIC702	Power & Info-Com technologies Infrastructure	20	20	20	80	3	-	-	100
CIDO701X	Department Optional Course- 5	20	20	20	80	3	-	-	100
ILO701X	Institute Optional Course- 1	20	20	20	80	3	-	-	100
CIL701	Waste Management Infrastructure	--	--	-	-	-	25	25	50
CIP701	Onsite training for Infrastructure project practices (Operations and Management)	--	--	--	-	-	50	50	100
CIP702	Major Project-I	--	--	-	-	-	50	50	100
Total		--	--	**80**	**320**	**-**	**175**	**75**	**650**

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. Tut.	Theory	Pract. Tut.	Total
CIC801	Quantity Survey, Estimation and Valuation	3	-	3		3
CIC 802	Infrastructure Management & Economics	3	-	3		3
CIDO801X	Department Optional Course-6	3	-	3	-	3
ILO801X	Institute Optional Course-2	3	-	3	-	3
CIL 801	Quantity Survey, Estimation and Valuation	-	2	--	1	1
CIP801	Onsite training for Infrastructure project practices (Finance and Business Communication)	-	8	-	4	4
CIP802	Major Project-II	-	10		5	5
Total		**12**	**20**	**12**	**10**	**22**

Examination Scheme

Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (Hrs.)			
		Test I	Test II	Avg.					
CIC801	Quantity Survey, Estimation and Valuation	20	20	20	80	3			100
CIC 802	Infrastructure Management & Economics	20	20	20	80	3			100
CIDO801X	DepartmentOptionalCourse-6	20	20	20	80	3			100
ILO801X	InstituteOptionalCourse-2	20	20	20	80	3			100
CIL 801	Quantity Survey, Estimation and Valuation	-	-	-	-	-	25	25	50
CIP801	Onsite training for Infrastructure project practices (Finance and Business Communication)	--	--	--	-	-	50	50	100
CIP802	Major Project-II	-	-	-	-	-	50	100	150
Total		**-**	**-**	**80**	**320**		**125**	**175**	**700**

Cumulative Credits

Semester	Credits and Marks	
	Credits	Marks
Sem I	18	675
Sem II	20	725
Sem III	23	800
Sem IV	24	825
Sem V	22	750
Sem VI	22	800
Sem VII	20	650
Sem VIII	22	700
Total	**171**	**5925**

Semester- III

Subject Code	Subject Name	Credits
CIC301	Engineering Mathematics – III	3

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	02	03	-	01	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 hrs	25	-	-	125

Pre-requisite: Engineering Mathematics – I,

Engineering Mathematics – II.

Objectives

1. To understand the concepts of statistics for data analysis and its statistical tools and applications
2. To learn and apply the concept of Linear Bivariate Correlation and Regression
3. To understand the concepts of probability distributions and apply different ways of distribution.
4. To characterize and analyze the testing of Hypotheses.
5. To extrapolate using sampling theory and figure out its applications.
6. To investigate Variance and Covariance and analyze the data.

Detailed Syllabus

Module		Course Modules / Contents	Periods
1		**Basic Statistical tools, their applications and interpretations.**	06
	1.1	Introduction of Statistics: Definition of statistics, types of data, collection of data, tabulation of data, sampling techniques, cleaning of data techniques, Plotting of graphs and Diagrams using Microsoft Excel etc.	

	1.2	Measures of Central Tendencies: Mean, Median, Mode, Quartiles, Deciles, Percentile. Graphical Location of these measures, merits and de-merits	
	1.3	Measures of Dispersion, Range, coefficient of range, Mean deviation, Standard deviation,Variance, coefficient of Variation, standard error of prediction	
2	**Linear Bivariate Correlation and Regression**		**06**
	2.1	Concept of bi-variate linear correlation, Scatter diagram, types of Correlations, Karl Pearson;s product moment coefficient of correlations, Spearman's Rank Correlation Coefficient.	
	2.2	Bi variate Linear regression.	
3	**Probability Distribution**		**06**
	3.1	Elementary Probability Theory (Revision), Binomial distribution.	
	3.2	Poisson distribution, Normal distribution	
4	**Testing of Hypotheses**		**06**
	4.1	Basic concepts related to Testing of Hypothesis, Hypothesis testing of means, for difference between the means, Hypothesis testing for comparing two related samples.	
	4.2	Hypothesis testing of proportions, between the proportions, for comparing variance to some hypothesized population variance, Limitations of tests of hypotheses.	
5	**Sampling and large sample tests**		**06**
	5.1	Basic sampling techniques, Chi-square test, student's t-test, F-test , Z-test	
	5.2	Random, Systematic, Convenience, Cluster, and Stratified sampling.	
	5.3	Sampling size, sampling errors.	
6	**Analysis of Variance and Covariance**		**09**
	6.1	ANOVA, its basic principles, two-way ANOVA. Analysis of Covariance (ANOCOVA)	
	6.2	MATLAB Commands and functions, Data representation in MATLAB, Basic arithmetic operations in MATLAB MAXIMA. symbolic computation, including differentiation and integration. Floating-point arithmetic and arbitrary-precision arithmetic. SAGEMATH. User Interfaces, Graphics, Mathematics, Parents andCategories.	
		Total	**39**

Contribution to Outcome

Learner will be able to….

1. Illustrate use of statistics for data analysis and apply it to real problems.
2. Employ the concept of Linear Bivariate Correlation and Regression.
3. Express probability distributions using proper technique.
4. Break down the data by means of testing of Hypotheses.
5. Correlate the data with the help of concept of sampling theory.
6. Manage the data by the virtue of Analysis of Variance and Covariance.

Term Work:

General Instructions: Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.

Students must be encouraged to write at least 6 class tutorials on entire syllabus.

Four tutorials will be based on:

i) MATLAB Commands and functions, Data representation in MATLAB, Basic arithmetic operations in MATLAB

ii) MAXIMA. Computer algebra system, symbolic computation, including differentiation and integration. floating-point arithmetic and arbitrary-precision arithmetic.

iii) SAGEMATH. User Interfaces, Graphics, Mathematics- Parents and Categories 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	MATLAB, MAXIMA and SAGEMATH Practical‘s	10 marks

Internal Assessment for (20 marks)

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination (80 marks)

Weightage of each module in end semester examination will be proportional to number ofrespective lecture hours mentioned in the curriculum.

1) Question paper will comprise of total six questions, each carrying 20 marks
2) Question 1 will be compulsory and should cover maximum contents of the curriculum
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 any module other than module
4) Only Four questions need to be solved.

Recommended Books:

1. 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. Advanced Engineering Mathematics: Erwin Kreyszig, Wiley Eastern Limited
5. Advanced Engineering Mathematics: R. K. Jain and S. R. K. Iyengar, Narosa publication
6. Probability Statistics and Random Processes: T. Veerarajan, Mc. Graw Hill education.

Semester- III

Course Code	Course Name	Credits
CIC302	Mechanics of Solids	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Durationof End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs	-	-	-	100

Rationale

Civil Engineering structures are made using various engineering materials such as steel, concrete, timber, other metals or their composites. They are subjected to force systems resulting in to axial forces, bending moments, shear forces, torsion and their combinations. Different materials respond differently to these by getting deformed and having induced stresses. Determination of stress, strain, and deflection suffered by structural elements when subjected to diverse loads is prerequisite for an economical and safe design.

In this course, learners will understand the behaviour, determine the internal forces and analyses the stresses of various structural element under action of different type of force systems. The knowledge of 'Mechanics of Solids' will be foundation of essential theoretical background for the subjects of Structural Analysis and Structural Design.

Objectives

1. To compute area moment of inertia and to learn stress - strain behavior and physical properties of materials and to compute the Stresses developed and estimate deformationof Elastic members under the action of axial forces and temperature change.
2. To learn relationship of distribution of axial force, shear force and bending moment for the loaded, statically determinate beams and portal frames and learn to represent graphically.

3. To analyze the distribution of shear stress and the flexural (bending) stress across the cross section of structural members.
4. To analyze and estimate the direct and bending stresses in columns and study buckling behavior of centrally and eccentrically loaded columns.
5. To analyze and determine the slope and deflection of elastic beams and general theorems used in this computation.
6. To relate the action of twisting moment with geometry of circular shafts and to determine strain energy stored in elastic members.

Detailed Syllabus

Module		Course Modules / Contents	Periods
1	**Moment of Inertia and Simple Stresses and Strains**		**08**
	1.1	**Moment of Inertia:** Area Moment of inertia, Parallel and Perpendicular axis theorem, polar moment of inertia. Radius of gyration. (Rectangular, Triangular, Circular, Semi-circular section and their combination)	
	1.2	**Simple Stresses and Strains:** Types of Stresses and Strains, stress-strain curve, different types of Elastic moduli and relationships between them, Poisson's ratio, factor of safety. Bars of varying sections, composite sections, temperature stresses	
2	**Axial force, shear force and bending moment diagrams for beams and portal frames**		**09**
	2.1	Concept of Axial Force, Shear Force and Bending Moment. a) Axial Force Shear Force and Bending Moment Diagrams for statically determinate Simply Supported and Cantilever **beams without internal hinges** and for single loading like point load, UDL, UVL or Couple moment. b) Axial Force Shear Force and Bending Moment Diagrams for statically determinate **beams with internal hinges** and combination of loading.	
	2.2	Axial Force Shear Force and Bending Moment Diagrams for statically determinate **3-member Portal Frames without internal hinges.**	
3	**Shear stresses and Bending stresses in beams**		**07**
	3.1	Distribution of shear stress across plane sections Commonly used for structural purposes.	
	3.2	Theory of pure bending, Flexure formula for straight beam, simple problems involving application of Flexure formula, section modulus,moment of resistance, flitched beams.	

4	**Stresses and Deflection of columns**		**08**
	4.1	Direct and bending stresses in Circular and rectangular Columns, Core of section, Determination of stresses.	
	4.2	Buckling of Columns, Members subjected to axial loading, concept of buckling, effective length, different support conditions, Determination of crippling load by Euler‘s and Rankine‘s formula.	
5	**Slope and Deflection in Beams**		**10**
	5.1	Slope and Deflection of Beams: Determination of Slope and deflection in beams, using Macaulay‘s method of double integration only. Simply supported or Cantilever beam of constant EI and subjected to Point load, UDL and Couple moment only shall be studied.	
	5.2	General Theorems of Slope and Deflection: Betti and Maxwell Reciprocal Theorem, Principle of Superposition, Principal of Virtual work. Application of Unit Load Method and Strain Energy Method (Virtual Work Method/ Dummy Load Method) for finding out slope and deflection in beams.	
6	**Torsion of Shafts and strain energy**		**10**
	6.1	Torsion in solid and hollow circular shafts, shafts with varying cross sections, Shafts transmitting and receiving power at different points.Stresses in Shafts while transmitting power.	
	6.2	Strain energy stored due to axial force (due to gradual, sudden and impact load) in regular solid and hollow bars. Strain Energy stored due to bending of beams.Strain energy stored in member due to torsion.	
		Total	**52**

Contribution to Outcome

On completion of the course, learner will be able to:

1. Understand concept of stress-strain and determine different types of stress, strain in determinate homogeneous and composite structures and Calculate Moment of Inertia for cross sections.
2. Calculate shear force and bending moment in statically determinate beams and portal frames for different loading conditions and illustrate axial force, shear force and bending moment diagram.
3. Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
4. Compute direct and bending stresses developed in the cross section of centrally and eccentrically loaded columns.
5. Evaluate slope and deflection of beams supported and loaded in different ways.
6. Use theory of torsion to determine the stresses in circular shaft and to calculate strain energy stored in members due to elastic deformation.

Internal Assessment (20Marks):

One **Compulsory Class Test,** based on approximately 40% of contents and another on 40% from the remaining content is taken. Average of the two will be considered as IA Marks.

End Semester Examination (80Marks):

Weightage of each module in end semester examination will be proportional to number of respective lectures.

Hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2. **Question 1**will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module3)Only Four questions need to be solved.

Recommended Books:

1. Strength of Materials: S. Ramamrutham, Dhanpatrai Publishers.
2. Strength of Materials: R. K. Rajput, S. Chand Publications.
3. Mechanics of Materials: Vol-I: S. B. Junnarkar and H. J. Shah, Charotar Publications.
4. Strength of Materials: Subramanian, Oxford University Press
5. Strength of Materials: S. S. Rattan, Tata Mc-Graw Hill, New Delhi
6. StrengthofMaterials(MechanicsofMaterials):R.S.LehriandA.S.Lehri,S.K.Katari a Publishers, New Delhi
7. Strength of Materials: Dr. V. L. Shah, Structures Publications, Pune

Reference Books:

8. Mechanics of Materials: James, M. and Barry J. ;Cengage Learning.
9. Mechanics of Materials: Andrew Pytel and Jaan Kiusalaas, Cengage Learning.
10. Mechanics of Materials: Timoshenko and Gere, Tata McGrawHill, New Delhi.
11. Mechanics of Materials: James M .Gere, Books/Cole.
12. Strength of Materials: G. H. Ryder, Mc-Millan.
13. Mechanics of Materials: E. P. Popov, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: Pytel and Singer, Mc-GrawHill, NewDelhi.
15. Strength of Materials: William A. Nash and Nillanjan Mallick, Mc Graw Hill BookCo. (Schaum‘s Outline Series)

Semester- III

Course Code	Course Name	Credits
CIC303	Modern Surveying	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Rationale

Surveying is the scientific technique to determine the position of points and angles & distances between them.. The process of surveying is necessary to accomplish all civil engineering works or projects successfully like highways, railways, bridges, airports, harbours, canals, dams reservoir sand waste water disposal.

In this core subject, students will learn about the principles and methods in surveying. They will study various conventional instruments which are used in the field for surveying.

For all infrastructures projects, very precise measurements are needed. Thus, the use of modern equipment and methods has become standard. It allows the gathering of much more accurate data in a time-efficient manner and aids in creating the best design possible. Students will learn about the Modern Surveying Instruments and methods, their suitability and applications.

Objectives

The students will be able to:

1. Understand appropriate principles and methods of surveying based on accuracy and precision required as per the availability of resources, economics and duration of theproject.
2. Learn to apply the technique for measurement of distances in vertical plane using surveying instruments.
3. Compare direct and indirect methods of measurement and decide the suitable method.
4. Acquire the knowledge of different curves and estimate the quantities.

5. Understand the Modern Surveying Instruments and methods and their suitability.
6. Demonstrate applications of modern instruments and techniques to real problem.

Detailed Syllabus

Module		Course Modules / Contents	Duration
1	**Introduction**		**06**
	1.1	Definition, principles, objectives, fundamental classification-plane and geodetic.	
	1.2	Chaining, Ranging and offsetting: Definitions, Principles, Instruments required, Obstacles, conventional signs and symbols.	
	1.3	Bearings – Different types, compass – prismatic, surveyor, dip, declination and local attraction, compass traversing.	
	1.4	Plane Table Surveying- principle, accessories and method.	
2	**Levelling and Contouring**		**05**
	2.1	Basic terms, principal axes of dumpy level, temporary and permanent adjustments.	
	2.2	Booking and reduction of levels.	
	2.3	Contouring: terms, contour, contouring, contour interval, horizontal equivalent, characteristics of contour lines.	
3	**Theodolite Surveying**		**08**
	3.1	Various parts and axes of transit, technical terms, measurement of horizontal and vertical angles.	
	3.2	Theodolite traverse, Latitudes and departures, traverse adjustments by Bowditch‘s and transit rule, Gales traverse table.	
	3.3	Tacheometery - Principle, Objective, Suitability and differentmethods of tacheometery, Stadia formula.	
4	**Curves**		**06**
	4.1	Horizontal Curves - Definitions of different terms, necessity and types of curves. Methods of setting out Simple circular curves- linear methods and Angular methods (Numericals on simple circular curves only).	
	4.2	Vertical curves – Definitions, geometry and types. Tangent correction and chord gradient methods.	
5	**Introduction to Modern Surveying Instruments Techniques**		**08**
	5.1	EDM	
	5.2	Electronic Theodolite	
	5.3	Total Station	
	5.4	Smart Station	
	5.5	GPS	

	5.6	GIS	
	5.7	Remote Sensing	
6	**Application of Modern Surveying Techniques**		**06**
	6.1	Application of Total Station, GIS, GPS, Remote Sensing, LIDAR, Drones.	
	6.2	Introduction to GRAM++, Q-GIS.	
		Total	**39**

Contribution to Outcome

After completion of the course, the learner will be able to:

1. Apply the principles and methods of surveying for project works.
2. Measure distances in vertical plane accurately.
3. Suggest solutions to the surveying field problems.
4. Apply the geometric principles for computing data and preparation of drawings.
5. Highlight the improvements in modern surveying instruments/techniques.
6. Use modern surveying tools to solve day to day surveying field problems.

Internal Assessment (20 marks):

Consisting of Two **Compulsory Class Tests:**

First test based on approximately 40% of the contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination (80 marks):

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

1. The question paper will consist of **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should cover **maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature**(for example if Q.2 has part (a) from module3 then part (b) will be from any other module other than module- 3)
4. Only **Four questions need to be solved.**

Recommended Books:

1. Surveying and Levelling: R. Agor, Vol. -I, 11th Edition, Khanna Publishers (ISBN8174092358)
2. Surveying and Levelling: Kanetkar and Kulkarni, Vol. -I, 24th Edition, PuneVidyarthiGriha, Pune. (ISBN 8185825114)
3. Surveying and Levelling: Dr. B.C. Punmia, Vol.-I, 16th Edition, Vol. -II 4th Edition,Laxmi Publications (ISBN9788170088530)
4. Surveying and Levelling: N N Basak, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN9789332901537)

5. Remote Sensing and GIS: B Bhatia, Oxford University Press, New Delhi.
6. Remote Sensing and Geographical Information Systems: M. Anji Reddy, B.S.Publications, Hyderabad, 2001
7. Concepts and Techniques of Geographic Information Systems: Lo, C.P. & Yeung A.K.W., PrenticeHall of India, New Delhi, 2002

Reference Books:

1. Surveying: Volume - I: Dr K.R. Arora, Standard Book House.
2. Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
3. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata McGraw Hill
4. Textbook of Surveying: C Venkatramaiah, University Press, Hyderabad, Latest Edition
5. Fundamentals of Surveying: S.K. Roy, Prentice Hall India, New Delhi
6. Surveying for Engineers: John Uraine and Bill Price, Palgrave Macmillan
7. Surveying: Theory and Practice, James Anderson, Edward M. Mikhail, Tata Mcgraw Hill
8. GIS, Spatial Analysis, and Modeling: Maguire, D., M. Batty, and M. Goodchild 2005.ESRI Press(070.212.05842005)
9. Global Positioning System: Signals, Measurements, and Performance, Pratap Misra andPerEnge (2nd Ed.), 2006.
10. Remote Sensing Principles and Interpretation: Floyd, F. Sabins, Jr:, Freeman and Co.,SanFranscisco,1978.
11. Geographic Information System and Science: Longley, Paul A., Michael F. Goodchild, David J.Maguuire, David W. Rhind, John Wiley and Sons, New York (2nd Ed.), 2005.

Semester- III

Subject Code	Subject Name	Credits
CIC 304	Basics of Infrastructure and its Planning	3

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Rationale

Infrastructure is the resources required for a society and its economy to function. It is instrumental in promoting economic growth of a nation. Infrastructure Planning primarily relates to new cost-effective infrastructure creation. Proper and consistent infrastructure planning and management is vitally important; it is crucial to the daily lives of millions of people. Infrastructure planning is primarily concerned with identifying the needs, the modes of operation, resources required, and financial implications of specific infrastructures. It focuses on managing, planning, and utilizing a facility.

In this course students will learn about Urban Infrastructure & Planning issues. The basics of infrastructure planning with respect to Housing and Industrial Development, Transportation Infrastructure, Water Supply & Irrigation and Power infrastructure will also be studied during this course.

Objectives

1. To understand the fundamentals of urban infrastructure and issues of urban planning.
2. To understand the housing development in urban and rural area and develop planning &designing of houses and housing complexes.
3. To understand the basics of industrial planning along with concepts in industrialdevelopment
4. To learn planning of the transportation infrastructure, and develop network system for theefficient transportation.

5. To summarize water management systems for water supply and irrigation.
6. To learn to prepare an outline for power generation at its sources and distribution ofpower.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	**Urban Infrastructure & Urban Planning issues**		7
	1.1	Introduction to Infrastructure & Planning fundamentals/concepts	
	1.2	Principles of Urban Infrastructure Management & Uses, Role ofGovernment, Municipality, Architect, Civil engineers, Contractors.	
	1.3	Urban Land Use Planning , Uses & important features, Models of executing infrastructure projects. Role of MMRDA, MSRDC, MHADA and CIDCO.	
2	**Housing Development**		7
	2.1	Introduction to Housing , its importance in Urban & Rural areas	
	2.2	Concepts for Planning, Designing for different types of Houses forall the types of income groups	
	2.3	Study of detailed Planning concepts for Residential Buildings &Residential Townships	
3	**Industrial Development**		5
	3.1	Introduction to various types of Industries & its uses in Economicdevelopment of any Region	
	3.2	Study of development of Industrial houses, planning concepts, authorities involved in the Industrial Development	
4.	**Transportation Infrastructure**		6
	4.1	Introduction to Transportation & its importance, development forany area development	
	4.2	Types of Transportation systems & networks, Planning concepts,Land acquisition for Transportation	
5.	**Urban Water Supply & Irrigation**		7
	5.1	Introduction to Water supply, Irrigation purpose	
	5.2	Planning concepts for water supply design, layouts, constructionparameters	
	5.3	Planning concepts for Irrigation projects, area development, agriculture requirements	

6.	**Power Generation & Distribution**		**7**
	6.1	Power requirement for Residential, Commercial & Industrial Development	
	6.2	Sources for Power Generation	
	6.3	Types of Power Plants, Installation & generation	
	6.4	Infrastructure Development for distribution of Power in all the modes of uses.	
		Total	**39**

Contribution to Outcome

Students will have the ability to:

1. Apply the infrastructural fundamentals and other issues in this regards.
2. Understand the requirements of housing development in urban and rural area.
3. Understand the basics of industrial development for the economic development of region.
4. Develop critical thinking on planning of transportation system, and importance fordevelopment of area.
5. Analyze the planning, designing and construction parameters for urban water supply andirrigation.
6. Prepare an outline of plan from source of power generation, types of plant andinfrastructural development for distribution of power

Theory Examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

Recommended Books:

1. Goodman A S, Hastak M (2006): Infrastructure planning handbook: planning,Engineering, and Economics. New York: ASCE Press.
2. Miller R, Lessard DR (2001): The strategic management of large engineering projects:Shaping institutions, risks, and governance. MIT press.
3. Infrastructure Planning and Management (2018): Prof. Ashwin Mahalingam NPTEL. https://nptel.ac.in/courses/105/106/105106188/
4. Infrastructure planning: J. Parkin and D. Sharma, Thomas Telford, London, 1999.
5. Planning, analysis, selection, financing, implementation, and review: P. Chandra,Projects: Tata McGraw-Hill, New Delhi, 2009.
6. Project Management : Vasant Desai, Himalaya Publishing , 1st Edition, 2010

Arbitration‖, Jubilee Publications, 2nd Edition., 1996 Engineering Contracts and B. J. Vasavada, ―

7. Construction Management & PWD Accounts --- D Lal, S. K. Kataria& Sons, 2012
8. Construction project scheduling and control --------Mubarak, Wiley India
9. Construction Management: Planning and finance-- Cormican D. Construction press,London, Feb 2002.
10. Engineering Economics—Kumar------ Wiley, India
11. Projects planning, Analysis Selection, Implementation and Review, Prasanna ChandraTata McGraw Hill, New Delhi, 2005
12. Fundamentals of Engineering Economics - Pravin Kumar, Wiley, India

Semester- III

Subject Code	Subject Name	Credits
CIC 305	Hydraulics	3

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	-	03	-	-	03

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Rationale

In Civil & Infrastructure engineering, the course of Hydraulics has been included to understand the Science of fluids. The course deals with the basic concepts of properties of Fluids, Fluid processes and Kinematics and hydrodynamics with their applications in fluid flow problems. Water infrastructure generally consists of water supply system comprising of network of pipes, channels from ground water to reservoir to consumer. Reservoirs, pipes, turbine and pumps are basic components of system and it is very essential to have knowledge about it.

The course deals with the basic concepts of properties of fluids, fluid kinematics and hydrodynamics with their applications in fluid flow problems. In this course, learners will understand the behaviour of Fluid under different conditions. The knowledge of 'Hydraulics' will be foundation of essential theoretical background for the subjects of Water Resources and Management Engineering as well as Environmental Engineering.

Objectives

1. To understand the different properties of fluids, pressure measurement, manometer, and hydrostatic forces acting on different surfaces, principle of buoyancy and stability of floating body.
2. To understand the Kinematic and Dynamic behaviour through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations to measure pipe bend problem.

3. To adapt and calculate various pipe flow losses, discharges in pipe network by Hardy cross method and power transmission through nozzle.
4. To understand working principle, classification, efficiencies of different types of Turbines.
5. To study centrifugal pumps, reciprocating pumps.
6. To understand prototypes, dimensionless numbers, dimensional analysis and model laws

Detailed Syllabus

Module		Course Modules / Contents	Periods
1	**Properties of Fluid**		06
	1.1	Various Properties of Fluids, Pressure of a Liquid, Pressure measurement: Pascal's law, Types of pressure, measurement of pressure, Total pressure and centre of pressure on different plane surface.	
	1.2	Buoyancy and floatation: Archimedes Principle, Metacenter, Metacentric height, stability of floating and submerged bodies, Determination of metacentric height.	
	1.3	Fluid Kinematics: - Rate of discharge, Equation of Continuity, types of flows in pipe.	
2	**Dynamics of Fluid Flow**		08
	2.1	Different types of Energies or Head of a Liquid in Motion, Equation of motion, Bernoulli's Equation for Real fluid.	
	2.2	Practical Application of Bernoulli's Equation, Venturimeter, orifice meter, pitot tube, orifice & mouthpiece. Classification of notches and weirs, discharge over a rectangular, triangular, trapezoidal notch/weir.	
	2.3	The Momentum Equation, Moment of Momentum Equation.	
3	**Flow through pipes**		08
	3.1	Loss of head through pipes, Darcy-Weisbach equation, Major and minor losses.	
	3.2	Hydraulic gradient line and Total energy gradient line.	
	3.3	Pipes in series, equivalent pipes, pipes in parallel, flow through laterals.	
	3.4	Flow through Branched pipes, three reservoir problem, and siphon.	
	3.5	Pipe network and water hammer, power transmission through nozzle	

4	**Turbines**		**08**
	4.1	Force exerted by jet on stationary, Moving (flat plate, inclined plate,curved plate) , jet striking at center and striking at tangentially at one end (including velocity triangle diagram) .	
	4.2	General layout, heads, efficiencies of turbine, classification.	
	4.3	Concept, working of Pelton wheel turbine, Francis turbines, Kaplan Turbines and draft tube.	
5	**Pumps**		**5**
	5.1	Centrifugal pumps, work done, heads, efficiencies.	
	5.2	Series, parallel operation, multistage pumps, specific speed, and cavitation.	
	5.3	Introduction to reciprocating pump.	
6	**Dimensional Analysis**		**4**
	6.1	Dimensional homogeneity, Buckingham‘s π theorem.	
	6.2	Dimensionless numbers & there significance.	
	6.3	Different Model laws.	
		Total	**39**

Contribution to Outcome

After completion of the course work, students will be able to,

1. Describe various properties of fluids and types of flows. Determine the pressure difference in pipe flows, application of Continuity equation and Bernoulli‘s theorem to determine velocity and discharge.
2. Apply the concepts of fluid dynamics to solve fluid flow problems.
3. Analyse major, minor friction losses through pipes, nozzles and apply it for solving complex water supply network problems by Hardy cross method.
4. Explain the working, functioning, of Francis, Kaplan and Pelton wheel turbines.
5. Explain the working, functioning and design of Centrifugal pumps, its efficiencies and study reciprocating pump.
6. Explain the importance of dimensionless numbers, dimension analysis and similarity behaviour of model and prototype

Internal Assessment (20 Marks):

Consisting of Two Compulsory Class Tests: First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents coveredin Test I).

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number ofrespective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1will be compulsory and should cover maximum contents of the curriculum
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 any module other than module 3)
4. Only Four questions need to be solved.

Oral Examination:

The oral examinations shall be based on the entire syllabus, the report of the experimentsconducted by the students including assignments.

Recommended Books:

1. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard BookHouse, Delhi
2. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hillpublishing company, New Delhi.
3. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
4. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane‘s Books Pvt.Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
5. Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
6. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.
7. Fluid Mechanics I & II: Dr. Atulya Patil, C Jamanadas Publication.

Reference Books:

8. Fluid Mechanics: Frank M. White, Tata McGraw Hill International Edition.
9. Fluid Mechanics: Streeter White Bedford, Tata McGraw International Edition.
10. Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Fanzine, E.J.Fennimore, Tata McGraw Hill, New Delhi.
11. Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGELearning India (Pvt.) Ltd.
12. Introduction to Fluid Mechanics: Edward J. Shaugh nessy, Jr, Ira M. Katz, James P.Schaffer Oxford Higher Education.

Semester- III

Subject Code	Subject Name	Credits
CIL 301	Mechanics of Solids (Lab)	1

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			EndSem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To learn stress-strain behavior and physical properties of materials and to compute the Stresses developed and deformation of Elastic members.
2. To learn computing the compressive stress in structural members.
3. To learn computing the flexural (bending) stress across the cross section of structural members.
4. To study the behavior of circular shafts under the action of twisting moment
5. To learn the concept of amount of energy absorbed by the material during fracture.
6. To learn the computation of slope and deflection of elastic beams and make use of general theorems used in this computation.

Term Work:
Term work comprises of Laboratory work and assignments.

Laboratory work: (At least 6-Performances –Any one from each Module)

Mechanics of Solids (Practical performance)		
Schedule	**Name of Experiment**	**Duration (Hours)**
1st week	1. Using UTM find different Moduli of a material or 2. The Tension Test on M S rod or 3. The Tension Test on M S Flat	**2**

3rd week	1. The Compression Test on Concrete cube or 2. The Compression Test on Timber or 3. The Compression Test on Brick	**2**
5th week	1. Test of Bending Using a Strain Guage or 2. Test of Bending Using a other electronic devices or 3. Test of Shear Stress in Beams	**2**
7th week	1. Using Torsion Testing Machine, verify the torsion equation, find different Moduli of a material. or 2. Spring Stiffness Test using strain gauges or other electronic devices	**2**
9th week	1. Charpy impact testing and Energy concept. or 2. Izod impact testing and Energy concept.	**2**
11th week	1. Using U T M perform experiments and verify Slope and deflectionequations, 3 points and 4 points loading. (Performance) or 2. Deflection of Simply supported Beams (Performance) or 3. Deflection of Cantilever Beams (Performance)	**2**
		Total Duration = 12 Hours

Assignment:

(At least 1 from each module as per the Course instructor‘s guidelines; it is to be assessed during Laboratory hours. In order to avoid Copying/ repetition, Course Instructor may give different assignments to different groups.)

Mechanics of Solids		
Schedule	**Assignment**	**Duration (Hours)**
2nd week	**Stresses and strains in Elastic members, Spherical and Cylindrical shells** 1. Prepare a model of Cylindrical vessel or 2. Prepare a model of spherical vessel or 3. Prepare a model of Cylindrical vessel with hemispherical ends or 4. Prepare a chart showing diagrammatic representation of stresses or 5. A set of 5 questions on a module designed by course instructor, or 6. A site visit to a relevant place or 7. A model / chart based on a module or 8. Design of a new experiment based on a module or 9. Write a Computer program in C++ or MS Excel on how to finda particular quantity from given data (Ex: Find output, Elongation ‗δ' from the input values of P,L,A and E) 10. A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document – Appendix I)	**2**
4th week	**Axial force, shear force and bending moment diagrams for beams and portal frames** 1. A set of 5 questions on a module designed by course instructor, or 2. A site visit to a relevant place or 3. A model / chart based on a module or 4. Design of a new experiment based on a module or 5. A chart about scientists and their contribution to the study of 'Mechanics of Structures' (Example given at the end of this document) or	**2**
	6. Prepare a chart showing AFD, SFD & BMD for different symmetric and asymmetric loads on S S beams or **7.** Prepare a chart showing AFD, SFD & BMD for different loads on Cantilever beams.	

6th week	**Area Moment of Inertia, Bending stresses and Shear stresses in beams** 1. Prepare a chart showing MI @ XX, YY &ZZ axes passing through the centroid. or 2. Prepare 3D models of different typical cross sections of beams and find their cross sectional area, Ixx, Iyy and Izz.. or 3. Prepare charts showing typical cross sections and variation of Bending stresses and shear stresses across the cross section. or 4. A set of 5 questions on a module designed by course instructor, or 5. A site visit to a relevant place or 6. A model / chart based on a module or 7. Design of a new experiment based on a module or 8. Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Flexural stress ‗f' from the input values of P,L,I and E) 9. A chart about scientists and their contribution to the study of 'Mechanics of Structures' (Example given at the end of this document)	**2**
8th week	**Columns** 1. Prepare 3D models of different solid and hollow circular cross sections of shafts and find their cross sectional area, Ixx, Iyy and Izz. or 2. A set of 5 questions on a module designed by course instructor, or 3. Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Shear stress 'q' or angle ‗Θ' from the input values of T,L,G and J) 4. A site visit to a relevant place or 5. A model / chart based on a module or 6. Design of a new experiment based on a module or 7. A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document)	**2**

10th week	**Torsion of Shafts, Strain Energy** 1. Draw typical stress transformation cases of Mohr's circle using graph paper. or 2. A set of 5 questions on a module designed by course instructor, or 3. A site visit to a relevant place or 4. A model / chart based on a module or 5. Design of a new experiment based on a module or 6. A chart about scientists and their contribution to the study of 'Mechanics of solids' (Example given at the end of this document)	**2**
12th week	**Slope and Deflection in Beams ; General Theorems** 1. Prepare chart to explain General theorems for slope and deflection. or 2. A set of 5 questions on a module designed by course instructor, or 3. A site visit to a relevant place or 4. A model / chart based on a module or 5. Design of a new experiment based on a module or 6. A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document)	**2**
	Total Duration =	**12 Hrs.**

Outcomes

Learner will be able to…

1. Evaluate stress-strain behavior of materials and assess the structural behavior by the virtue of stresses developed and deformation of elastic members.
2. Analyze the material response under the action compression and compute the compressive stress in structural members.
3. Evaluate flexural (bending) stress across the cross section of structural members like beams supported and loaded in different ways.
4. Predict the angle of twist and shear stress developed in torsion.
5. Analyze the material response under the action of impact load.
6. To make the computation of slope and deflection of elastic beams and apply general theorems used in this computation.

Appendix -I:

A chart about scientists and their contribution to the study of 'Mechanics of solids' be made by students. Contributions of Scientists like Giordano Riccati, Leonhard Euler, Saint Venant, Christian Otto Mohr, William J M Rankine, Carlo Castigliano, Enrico Betti, Robert Hooke, W. H. Macaulay, Augustin- Louis Cauchy, Simeon Poisson can be studied and presented.

Important Websites:

1. http://www.iitk.ac.in/mseold/mse_new/facilities/laboratories/MaterialTestingLab/MSE313A.pdf
2. https://home.iitm.ac.in/kramesh/Strength of Materials Laboratory Manual.pdf
3. https://www.researchgate.net/publication/338139499_Me_8381-Strength_Of_Materials_Lab_Manual

Assessment:

To be done after 13th week

Term Work:

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work- : 15 Marks

Assignments- : 10 Marks

The sum will be multiplied by a factor of attendance between (for poor attendance) to 1 (verygood attendance).

End Semester Oral Examination

Oral examination will be based on entire syllabus

Recommended Books:

1. Strength of Materials: S. Ramamrutham, Dhanpatrai Publishers.
2. Strength of Materials: R. K. Rajput, S. Chand Publications.
3. Mechanics of Materials: Vol-I: S. B. Junnarkar and H. J. Shah, Charotar Publications.
4. Strength of Materials: Subramanian, Oxford University Press
5. Strength of Materials: S. S. Rattan, Tata Mc-Graw Hill, New Delhi
6. StrengthofMaterials(MechanicsofMaterials):R.S.LehriandA.S.Lehri,S.K.Kataria Publishers, New Delhi
7. Strength of Materials: Dr. V. L. Shah, Structures Publications, Pune

Reference Books:

8. Mechanics of Materials: James, M. and Barry J.; Cengage Learning.
9. Mechanics of Materials: Andrew Pytel and Jaan Kiusalaas, Cengage Learning.
10. Mechanics of Materials: Timoshenko and Gere, Tata McGrawHill, New Delhi.
11. Mechanics of Materials: James M .Gere, Books/Cole.
12. Strength of Materials: G. H. Ryder, Mc-Millan.
13. Mechanics of Materials: E. P. Popov, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: Pytel and Singer, Mc-GrawHill, NewDelhi.
15. Strength of Materials: William A. Nash and Nillanjan Mallick, Mc Graw Hill BookCo.(Schaum's Outline Series)

Semester- III

Subject Code	Subject Name	Credits
CIL 302	Modern Surveying (Lab)	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	25	75

Objectives

The students will be able to:

1. Study various surveying instruments, their least counts, various parts and suitable uses.
2. Apply methods of measurements in the field.
3. Demonstrate skills for collecting, recording and analyzing the field data.
4. Learn advanced instruments/techniques.
5. Acquire first hand practical experience by receiving field exposure to collect site specificdata.
6. Exhibit setting out techniques.

Outcomes

At the end of the course, learner will be able to:

1) Operate and use the surveying instruments.
2) Measure linear and angular dimensions in horizontal and vertical planes.
3) Collect record and analyze the field data systematically.
4) Compare advanced instruments/ techniques with the conventional ones.
5) Prepare the drawings from the collected data in the form of plans, sections and contours.
6) Set out curves and foundation plans.

List of practical's and projects:

Performance of minimum six experiments out of list of 10 experiments and all the projects are mandatory.

Module	Detailed Contents	Lab Sessions /Hr
1	Chain and compass surveying.	03 hrs
2	Simple and compound leveling practices	03 hrs
3	Measurement of horizontal angles and vertical angles using a Theodolite.	03 hrs
4	Measurement of distances, bearings and area using total station.	03 hrs
5	Plane Table Surveying by intersection method.	03 hrs
6	Find constants, heights and distances using Tacheometery.	03 hrs
7	Setting out a simple circular curve.	03 hrs
8	Setting out a simple foundation plan.	03 hrs
9	Determination of co – ordinates and lengths of a profile using GPS.	03 hrs
10	Analysis of survey projects conducted using various softwares.	03 hrs

Projects:	
A survey camp of three days is to be arranged to execute the following projects for undergoingthe students through practical instructions in civil engineer's career with the actual field exposure at an ideal site location.	
1	**Project I:** Road project using Auto level for a minimum length of 500 m including fixing of alignment, profile leveling, cross-sectioning at 20m interval, plotting of 'L' section and 'C' section. (Two full imperial sheets, the first sheet with key plan and ' L' section and the second sheet covering any three typical Cross-sections)
2	**Project II:** Block Contouring project using Auto level for minimum 60 m × 60 m Area and generating contours by MS Excel. (Take contour interval as 0.2 meter)
3	**Project III:** Tachometric contouring project on a hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours by taking Contour intervals as 1 meter.

Assessment:

Teamwork - Including above practical work, projects and assignments, distribution of marks for Term Work shall be as follows:

Practical Work	:	15 marks
Assignments	:	05 marks
Attendance	:	05 marks

Projects-

Field work	:	15marks
Office work (Drawings)	:	10marks
Total	**:**	**50marks**

End Semester Practical/ Oral Examination

Practical Examination	:	10 Marks
Oral Examination	:	15 Marks.

- **Oral examination will be conducted after conduction of practical examination & itwill be based on term work & Practical examination.**

Reference Books:

1. Surveying and Levelling : R. Agor, Vol-I, 11th Edition, Khanna Publishers (ISBN 8174092358)
2. Surveying and Leveling: Kanetkar and Kulkarni,Vol-I, 24th Edition, Pune Vidyarthi Griha, Pune. (ISBN 8185825114)
3. Surveying and Levelling : Dr. B.C. Punmia, Vol.-I, 16th Edition, Vol -II 4th Edition, Laxmi Publications (ISBN9788170088530)
4. Surveying and Levelling: N N Basak, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN 9789332901537)
5. Surveying: Vol-I: Dr K.R. Arora, Standard Book House.
6. Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
7. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata Mc-Graw Hill
8. Global Positioning System: Signals, Measurements, and Performance, Pratap Misra (2nd Ed.), 2006.
9. Imaging Radar for Resource Survey: Remote Sensing Applications: W. Travelt, Chapman and Hall.
10. A Remote Sensing Perspective: Introductory Digital Image Processing: John, R. Jensen, Prentice Hall.
11. Remote sensing and Image interpretation, T.M Lilles, R.W Kiefer and J.W Chipman,5th edition,John Wiley and Sons India

Semester- III

Subject Code	Subject Name	Credits
CIL 303	Hydraulics (Lab)	1

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Durationof End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To acquire basic of Archimedes principal.
2. To illustrate Bernoulli‘s Equations from Experiment.
3. To understand the concept of how to find major and minor friction losses throughdifferent pipes, bend, elbow, sudden contraction, enlargement.
4. To study the performance and efficiencies of various types of Turbines.
5. To study the performance of Centrifugal pump.
6. To analyze the discharge through Venturimeter, orifice meter, mouthpiece, rectangular, notches, triangular notch.

List of Experiments (Any six)

Module	Detailed Contents	Lab Sessions/Hr
1	Verification of Archimedes principle	**2**
2	Verification of Bernoulli‘s Equations experimentally.	**2**
3	Determination of Major and Minor Friction losses through different pipes, bends, elbow, sudden enlargement, contraction.	**2**
4	Performance of Pelton wheel Turbine, Kaplan, and Francis with – half or full gate opening.	**2**
5	Performance of Centrifugal pumps.	**2**
6	Verification of Pascal‘s Law.	**2**
7	Determination of coefficient of discharge of Venturimeter, Orifice meter, Nozzle meter, of mouthpiece.	**2**
8	Determination of coefficient of discharge of Notches (Rectangular and Triangular notch).	**2**
9	Determination of coefficient of discharge of weirs (Broad Crested weir and Ogee weir).	**2**
10	Types of materials of pipes GI, PVC, UPVC, CPVC and study of different types of fixtures in pipes like, valves, reducer, T, Elbow, coupling.	**2**

Contribution to Outcome

Learner will be able to…

1. Understand the Archimedes principal.
2. Explain Bernoulli‘s experiment.
3. Analyze the major and minor friction losses.
4. Find out efficiencies of Different turbines.
5. Analyze the coefficient of discharge through Venturimeter, orifice meter, mouthpiece, rectangular notch, triangular notch.
6. Study the performance of centrifugal pump.

Assessment

Term Work Including
Practical work- :10 Marks

Assignments- : 10 Marks

Attendance : 05 Marks

End Semester Oral Examination

Oral examination will be based on the entire syllabus.

Recommended Books:

1. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard BookHouse, Delhi
2. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hillpublishing Company, New Delhi.
3. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
4. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane‘s Books Pvt.Ltd. (RevisedEdition 2012), ISBN 97893 8116 2538
5. Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
6. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.
7. Fluid Mechanics I & II: Dr. Atulya Patil, Jamanalal Publication.

Reference Books:

1. Fluid Mechanics: Frank M. White, Tata McGraw Hill International Edition.
2. Fluid Mechanics: Streeter White Bedford, Tata McGraw International Edition.
3. Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Fanzine, E.J.Fennimore, Tata McGraw Hill, New Delhi.
4. Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGELearning India (Pvt.) Ltd.
5. Introduction to Fluid Mechanics: Edward J. Shaugh nessy, Jr, Ira M. Katz, James P.Schaffer. Oxford Higher Education.

Semester- III

Subject Code	Subject Name	Credits
CIL 304	Skill Based Lab Course – I	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Durationof End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	-	50

Objectives

1. To enable the learners efficiently draft and label buildings components use the concepts of 2D and 3D drawing and detailing.
2. To introduce the concepts of object-based modelling in 3-D environment to learners.
3. To enable the learners to work on drawing and drafting on CAD software so that they can conveniently understand and design civil engineering components through the software.
4. To understand Creating families and basic models on BIM.
5. To learn creating architectural plan on BIM of a G+1 bungalow.
6. To learn create demonstration of a walkthrough on BIM for clients and presenting it.

List of Experiments (Minimum Eight)		
Module	**Detailed Content**	**Lab Session / Hr.**
1	Listing out the various Computer Aided Drawing and Drafting (CADD) tools available for civil engineering projects in the market	3
	and highlighting the capabilities and advantages of each	
2	Basic introduction to compatibilities, utilities and attributes of peculiar drafting softwares w.r.t their various commands, features, capabilities and functions.	3
3	Line plan of a residential structure using a CADD tool	3

4	Developed plan of a residential structure (minimum G+4) using a CADD tool	6
5	Developed plan of a public building using a CADD tool	6
6	Basic introduction to compatibilities, utilities and attributes of peculiar building information modelling (BIM) softwares w.r.t their various commands, features, capabilities and functions	3
6	Creating families and basic models on BIM	6
8	Creating architectural plan on BIM of a G+1 bungalow	3
9	Demonstrating a walkthrough on BIM for clients and presenting it	3
10	Clash detection and removal.	3

Contribution to Outcome

At the end of the course, learner will be able:

1. Transfer the plan from a drawing sheet to a 2-D drafting software
2. Visualize the various elements in the software like points, lines, polygons, etc. as objects of the real world and relate it with civil engineering components.
3. Apply civil engineering concepts to draft efficient civil engineering plans in accordance to various building bye laws and forms.
4. Conceptualize the space, logistic and statutory constraints in the real world to draw an efficient plan so that optimization is achieved
5. Attach and retrieve information pertaining to various civil engineering components through 3-D modelling software
6. Demonstrate a virtual walkthrough of buildings.

Assessment:

Term Work: Including Laboratory Work comprising of minimum 6 software generated reports/sheets/program outputs with one walkthrough presentation on BIM, distribution of marks for Term Work shall be as follows:

Laboratory Work	:	30 Marks (comprising of minimum 6 software generated sheets)
Presentation	:	10 Marks (3D walk through of the building)
Attendance	:	10 Marks

Reference Books:

1. Software manuals
2. Refereed Journal papers on Software applications

Semester- III

Subject Code	Subject Name	Credits
CIM 301	Mini Project -1 A	1

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	1	-	1

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test- I	Test- II	Average						
-	-	-	-	-	25	-	25	50

Rationale

From primitive habitats of early years to modern infrastructure, the civil engineering industry's growth has been need based and society centric. Civil and infrastructure engineers deal with many challenges on daily basis that most people do not have any idea. Mumbai University proposed Mini projects in the syllabus so that the budding civil engineers can connect with the world outside their textbooks and have the idea of future course.

The Mini project should actually provide solution to a typical problem after a brainstorming and in a stipulated period. The competitions ahead will give students the experience of the civil engineering industry's real-world problems and make students brainstorm ideas, learn, and explore the civil engineering industry.

Objectives

1. To recognize societal problems and convert them into a problem statement by understanding of facts and ideas in a group activity. (BTL-2)
2. To deal with new problems and situations by applying acquired knowledge, facts, techniques and rules in a different way. (BTL-3)
3. To examine and break information into parts, by analyzing motives or causes. (BTL-4)
4. To learn evaluating information, validity of ideas and work based on a set of criteria.(BTL-5)
5. To create solutions by compiling information together in a novel way. (BTL-6)
6. To design model by combining elements in a new pattern or proposing new solutions. (BTL-6)

Contribution to Outcome

Learner will be able to…

1. **Identify** problems based on societal/research needs and formulate a solution strategy.
2. **Apply** fundamentals to develop solutions to solve societal problems in a group.
3. **Analyze** the specific need, formulate the problem and deduce the interdisciplinary approaches, software based solutions and computer applications.
4. Develop systematic flow chart, **evaluate** inter disciplinary practices, devices, available software, estimate and recommend possible solutions.
5. Draw the proper inferences from available results through theoretical/experimental/simulations and **assemble** physical systems.
6. **Create** devises or design a working model for a particular application.

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 hall 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 ofeach 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 bystudents group.
- First shall be for finalization of problem
- Second shall be on finalization of proposed solution of problem.
- In second semester expected work shall be procurement of components /systems, buildingof 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 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:

- 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

Semester – IV

Course Code	Course Name	Credits
CIC401	Engineering Mathematics – IV	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	02	03	-	01	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	25	-	-	125

Pre-requisite:

- Engineering Mathematics-I,
- Engineering Mathematics-II,
- Engineering Mathematics-III.

Objectives

1. To understand Eigen values and Eigen vectors and employ matrix operations.
2. To interact with the complex variables apply equations and methods to complex variablesand their applications.
3. To understand concept of Fourier series, their complex forms and solve the problem.
4. To learn computing using partial differential equation and explore the suitable numericalmethods.
5. To practice Multivariate Data Analysis techniques and understand their characteristics.
6. To learn the basic operations of Statistical R Software for matrix analysis

Detailed Syllabus

Module		Course Modules/Contents	Duration
1	**Eigen values and Eigen vectors**		7
	1.1	Characteristic equation, Eigen values and Eigenvectors, Propertiesof Eigen values and Eigen vectors.(**No theorems/proof**)	
	1.2	Cayley- Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix, Functions of square matrix.	

	1.3	Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	
2	**Complex Variable**		**7**
	2.1	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), Cauchy-Riemann equations in cartesiancoordinates (without proof)	
	2.2	Milne-Thomson method to determine analytic function f(z) when realpart (u) or Imaginary part (v) or its combination (u+v or u-v) is given.	
	2.3	Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping,cross ratio, fixed points and standard transformations	
3	**Fourier Series**		**7**
	3.1	Dirichlet‘s conditions, Definition of Fourier series and Parseval‘s Identity (without proof), Fourier series of periodic function with period 2π and 2l	
	3.2	Fourier series of even and odd functions	
	3.3	Half range Sine and Cosine Series.	
4	**Partial Differential Equation and Numerical Methods**		**6**
	4.1	Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems)	
	4.2	Crank Nicholson method, Bender Schmidt method Self-learning Topics: Analytical methods of solving two and threedimensional problems.	
5	**Multivariate Data Analysis techniques**		**6**
	5.1	Multiple Regression, Multiple analysis of Variance, Factor analysis, Principal Component analysis	
	5.2	Characteristics of multivariate data analysis techniques, Examples of multivariate regression	
6	**Introduction of Statistical R Software**		**6**
	6.1	Introduction of R software, command line, Data editor, Rstudio, Basics of calculations, Built in functions.	
	6.2	Matrix operations, Missing data, Logical operators, Truth tables and conditional executions.	
		Total	**39**

Contribution to Outcome

Learner will be able to….

1. Operate Eigen values and Eigen vectors to solve engineering problems.
2. Predict orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
3. Relate the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Calculate Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations.
5. Illustrate understanding of the concepts of Multivariate Data Analysis techniques.
6. Compute using the Statistical R Software for analysis of matrices.

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 for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each tests hall be one hour.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number ofrespective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2has part (a) from module3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

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, Mc.Graw Hill education.
6. Textbook of Matrices: Shanti Narayan and PK Mittal, S. Chand Publication

Semester – IV

Course Code	Course Name	Credits
CIC402	Structural Analysis	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	-	-	04	-	-	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

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Rationale

Different components of civil engineering structures are subjected to various force systems and their combinations. For designing the components, these are analyzed for their response. The structural systems are determinate or indeterminate in nature and so there are different analysis methods. These will be learnt in this course. Subject knowledge of Engineering Mechanics and Mechanics of solids is the prerequisite of this course.

Their application on solids and mechanisms, the action of force systems is studied and further extended in this subject. Learner will learn to apply these to the analysis of various members of structural systems such as beams, trusses, portal frames and arches. These analyses will further be used while designing of Steel and RCC structures.

Objectives

1. To analyze for axial force in the Coplanar, perfect trusses and analysis of statically determinate truss for finding deflection at joints using unit load and strain energy method.
2. To interpret the concept of Influence Line Diagrams for Reactions, SF and BM in

beams and axial forces in trusses and their application for rolling load systems.

3. To compute static and kinematic indeterminacy (degrees of freedom) of the structures such as beams, rigid jointed and pin jointed frames.
4. To analyze the indeterminate structures using Flexibility method.
5. To analyze the indeterminate structures such as beams & simple rigid jointed frames using slope deflection, moment distribution and direct stiffness method
6. To articulate the concept of plastic hinge, plastic moment carrying capacity, shape factor and collapse load for single and multiple span beams.

Detailed Syllabus

Module		Course Modules/Contents	Duration
1	**Analysis of truss and deflection of truss joints**		**(10)**
	1.1	**Trusses**: Analysis of Perfect Coplanar Trusses by Method of Joints.	**04**
	1.2	**Deflection of truss joints:** Application of Unit Load Method and Strain Energy method for calculating deflection of a point on Pin jointed truss.	**06**
2	**Influence line diagrams and rolling loads**		**(08)**
	2.1	Influence lines for Reactions, shear force and bending moment at a section of cantilever, simply supported, overhanging beams without internal hinges. Rolling loads, Determination of S F and BM at a section, Value and criteria for maximum shear force and bending moment.	**05**
	2.2	Absolute maximum shear force and bending moment under rolling loads (UDL and series of point loads) for simply supported girder.	**03**
3	**Determinate and Indeterminate structures**		**(05)**
	3.1	Static and kinematic indeterminacies: Types of structures occurring in practice, their classification, linear and non-linear behavior of materials, geometric non-linearity, static and kinematic determinacy and indeterminacy of structure.	**05**
4	**Analysis of indeterminate structures by Force method**		**(05)**
	4.1	Flexibility coefficients and their use in formulation of compatibility equations. Application of flexibility method to propped cantilevers, fixed beams & continuous beams, Simple rigid jointed frames.	**05**
5	**Analysis of indeterminate structures by displacement methods**		**(18)**
	5.1	**Slope Deflection method:** Application to indeterminate beams &	**06**

		simple rigid jointed frames having up to three degrees of freedom including the effect of support settlement.	
	5.2	**Moment distribution method:** Application to indeterminate beams & simple rigid jointed frames having up to three degrees of freedom including the effect of support settlement.	**06**
	5.3	**Direct stiffness method:** Stiffness coefficients for prismatic members and their use for formulation of equilibrium equations. Application of Direct stiffness method to indeterminate beams & simple rigid jointed frames.	**06**
6	**Plastic analysis of structures**		**(06)**
	6.1	Introduction to plastic analysis, concept of plastic hinge, plastic moment carrying capacity, shape factor. Kinematic method of plastic analysis. Determination of collapse load for single and multiple span beams.	**06**
		Total	**52**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Calculate axial forces in the Coplanar trusses by using Method of joints and calculate the deflection of truss joints using Unit load method and strain energy method.
2. Draw Influence Line Diagrams for axial forces in trusses, Reactions, SF and B M in beams and find their values when rolling loads are passing over them.
3. Evaluate rotation and displacement at a joint in frames with the understanding of static and kinematic indeterminacy of structure.
4. Analyze the indeterminate structures such as beams & simple rigid jointed frames using force method (Flexibility) to analyze the indeterminate structures.
5. Analyze the indeterminate structures such as beams & simple rigid jointed frames using displacement method like slope deflection, moment distribution and direct stiffness method.
6. Understand the behaviour of various statically indeterminate beams under plastic state.

Internal Assessment (20Marks):

Consisting **Two Compulsory Class Tests** First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

End Semester Examination (80Marks):

Weightage of each module in end semester examination will be proportional to number ofrespective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).
4. **Only** Four questions need to be solved**.**

Recommended Books:

1. Basic Structural Analysis: C. S. Reddy, Tata McGraw Hill NewDelhi.
2. Mechanics of Structures: Vol-I: S. B. Junnarkar and H.J.Shah, Charotar Publishers,Anand.
3. Analysis of Structures: Vol.I and II, Vazirani and Ratwani.
4. Strength of Materials: S. Ramamrutham, Dhanpatrai and Publishers, Delhi
5. Theory of Structures: S. Ramamrutham, Dhanpatrai and Sons, Delhi
6. Structural Analysis- I: Hemant Patil, Yogesh Patil, Jignesh Patel, Synergy Knowledgeware, Mumbai.
7. Strength of Materials: Rajput, S. Chand Publications, Delhi
8. Structural Analysis: Bhavikatti, Vikas publisher house Pvt, ltd.
9. Structural Analysis: Devdas Menon, Narosa Publishing House.
10. Basic Structural Analysis: K.U. Muthu, AzmiIbrahim, M.Vijyanand, Maganti Janadharnand. I.K. International Publishing House Pvt. Ltd.
11. Elementary Structural Analysis: Jindal
12. Structural Analysis: L.S. Negi and R. S. Jangid, TataMc-Graw Hill India.
13. Structural Analysis: T.S. Thandavamoorthy, Oxford University Press.
14. Structural Analysis: Manmohan Das, BharghabMohan Pentice Hall International.

Reference Books:

1. Structural Analysis: Hibbler, Prentice Hall International.
2. Structural Analysis: Chajes, ElBS London.
3. Theory of Structures: Timoshenko and Young, Tata Mc Graw Hill NewDelhi.
4. Structural Analysis: Kassimali, TWS Publications.
5. Element of Structural Analysis: Norris and Wilbur, McGraw Hill.

6. Structural Analysis: Laursen H.I, McGraw Hill Publishing Co.
7. Structural theorem and their application :B.G.Neal, Pergaman Press.
8. Elementary theory of Structures: Hsieh, Prentice Hall

Semester- IV

Course Code	Course Name	Credits
CIC403	Town and Country Planning	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Rationale

Town and country planning is necessary to ensure that all development is co-ordinated with an eye to the future, and carried out in such a way that it will assist in producing a community environment that will advance human welfare in health, well-being and safety.

It provides guidance and instructions to Planners, Architects, and Engineers on how to Plan, Design & Construct a small/bigger town as well as small Region for overall development in terms of Housing, Industrial and all Infrastructure facilities to be provided. Completed & Approved drawings are necessary to know the future cost & probable time period required for development of a Town or any Region/District level, as a whole.

Objectives

1. To remember and recall the intricate details of basic requirements for Town & Country Planning.
2. To understand the preparation of drawings for Town/District in terms of all basic Infrastructure.
3. To learn how to apply professional ethics and act responsibly pertaining to the norms of building Planning, design and drawing practices, rules, regulation and byelaws, Building codes.
4. To identify, analyze, research literate and solve Town design and preparing drawings as a whole.

5. To have innovative solutions for complex planning & design of Towns & small regions in a district.
6. To effectively communicate ideas, related to drawings prepared, both orally as well as in written format like reports & drawings for small& big Cities.

Detailed Syllabus

Module		Course Modules/Contents	Duration
1	**Planning of Individual Houses, Apartment's scheme**		7
	1.1	Introduction to all Residential Houses, Apartments Concept & its importance	
	1.2	Planning concepts for Individual Houses & Apartments	
	1.3	Planning, Designing & Drawing of any one Residential Bungalow, Apartment	
	1.4	Introduction to CAD (Computer Aided Drawing) in Civil Engineering & Planning –Basic Concepts	
	1.5	Study of any one of the professional CAD software's-Introduction	
2	**Town Planning Concepts**		7
	2.1	Introduction to Town planning	
	2.2	Principles of Town Planning	
	2.3	Planning of Land-Use for development of a Town	
	2.4	Plan & Design of any TOWN, with all infrastructure	
3	**Regional planning Concepts**		7
	3.1	Introduction to Regional Planning	
	3.2	Principles of Regional Planning	
	3.3	Planning of Land-Use for development of a Region	
	3.4	Plan & Design of any Region/District, with all infrastructure	
4.	**City & Industrial Development**		6
	4.1	Study of development concepts for Cities & Industries	
	4.2	Planning concepts for CITY & Industry	
	4.3	Planning, designing & drawing of a CITY, with respect to Lane-use	
	4.4	Planning, designing & drawing of Industry cluster, with respect to Lane-use	
5.	**Road planning, Electrical, Water Supply, Sewer lines**		6
	5.1	Introduction & Importance of Roads, Water Supply, Sewage & Electricity for City/Rural area development	

	5.2	Planning & Design concepts for Road development within the Town & outside the Town	
	5..3	Planning & Design concepts for Electrical, Water Supply, Sewer lines within the Town & outside of the Town	
6.	**Smart Cities development**		**6**
	6.1	Introduction to Smart City	
	6.2	Development & Planning concepts for Smart City Development	
	6.3	Basic Infrastructure development requirements for Smart City.	
	6.4	Planning & Designing a Smart City, Land-Use allocation	
		Total	**39**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Will learn to apply the policy planning for Town Planning & Regional Planning.
2. Understand the basic concepts of innovation in planning concepts for Towns & Villages.
3. Learn how to apply professional ethics and act responsibly pertaining to the norms of Town Planning and drawing practices.
4. Identify, analyze, research literate and solve complex issues related to drawings of Towns & Villages.
5. Have new innovative solutions for complex issues like Master Plan & Regional Plan.
6. To effectively communicate ideas related to drawings prepared, both orally as well as in written format like reports & drawings for small& big Cities.

Internal Assessment (20Marks):

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

End Semester Examination (80 Marks):

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

1. Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module3then part (b) will be from any module other than module-3).

4. Only **Four questions need to be solved.**

Recommended Books:

1. Building Drawing with an Integrated Approach to Built Environment by M. G. Shah, C. M. Kale, S.Y. Patki (Tata McGraw-Hill Education)
2. Town planning by S.C Rangwala
3. Text Book of TOWN PLANNING – G. K. Bandopadhyaya
4. Town & Country Planning by TCPO, New Delhi
5. Rural Development in India-Past, Present & Future- Dr. Vasant Desai
6. Traffic Engg. & Transport Planning by L.R Kadiyali
7. Principles of Urban Transportation Systems Planning by B.G. Hutchison
8. Urban Economic Development in India by V.V. Subrahmanyam & R L Bawa
9. An Introduction to Town & Country Planning by John Ratcliff (The Built EnvironmentSeries)
10. Housing-An Indian Perspective by P K Guha
11. Smart City in India by Binti Singh, Manoj Parmar
12. Industrial Development in India by M Gangadhara Rao, Odeyar D, Heggade

References:

1. IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
2. Maharashtra Regional & Town Planning Act,1966
3. Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (https://mmrda.maharashtra.gov.in)
4. Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (https://www.nmmc.gov.in/development-control-regulations)
5. Development Plan and Control Regulation KDMC, https://mmrda.maharashtra.gov.in
6. The Economics of Development & Planning by M.L.Jhingam

Reference Codes:

1. National Building Code of India, 2005.
2. IS 1172-1983 Code of Basic Requirement for Water Supply, Drainage & Sanitation.
3. Amendments in Town & Country Planning Legislation, Land-Use Zoning by NationalDisaster Management Divn., Govt. of India, New Delhi

Semester- IV

Course Code	Course Name	Credits
CIC404	Concrete Technology, Building Materials and Construction Equipment	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Rationale

Materials are essential elements, constituent parts (or) substances which are used to raise a building, but materials could not be turned into structures without a method of construction. This course provides necessary knowledge about properties, uses of different types of building materials, selection of materials, its mix proportioning and equipment used for the construction.

This course is intended for gaining useful knowledge with respect to materials, concrete technology, procedures related to building materials, and construction equipment so that student can learn the aspects required to execute quality during construction work.

Objectives

1. To acquire knowledge about the different constituent materials and their composition in concrete and study of its mix design as per the need.
2. To articulate the important properties of fresh and hardened concrete and corresponding tests conducted for assurance of concrete in terms of properties.
3. To acquire knowledge about the properties of different building materials like brick, timber, steel, concrete blocks and chemicals.
4. To understand the techniques of field and laboratory testing, and awareness of recyclability and Sustainability of Building Materials.
5. To acquire knowledge of machinery and equipment used in construction activities, their types and suitability.
6. To learn the working and usage of heavy equipment and vehicles for various construction activities.

Detailed Syllabus

Module		Course Modules / Contents	Duration
1	**Constituent of Concrete and Mix design**		8
	1.1	Cement - Different types – Chemical composition and Properties – Hydration of cement – Tests on cement – IS Specifications. Aggregates - Classification -Mechanical properties and tests as perBIS – Grading requirements. Water - Quality of water for use in concrete. W/C ratio. Admixtures - Accelerators – Retarders – Plasticizers – Super plasticizers – Water proofers – Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline – Effects on concrete properties.	
	1.2	Principles of Mix Proportioning, Mix Design – Design Mix and Nominal Mix – BIS Method of Mix Design - Mix Design Examples, Calculation of ingredients of concrete for batching as per concrete mix proportions for different grades.	
2	**Properties of concrete and testing**		8
	2.1	Workability of concrete, Segregation and Bleeding, Creep and shrinkage. Properties of Hard concrete, Compressive strength, split tensile strength, Flexural strength, Stress-strain curve for concrete, Modulus of elasticity.	
	2.2	Types of concrete, Durability of concrete, Causes of loss of durability. Tests on concrete- UPV, Rebound Hammer, Carbonation, permeability.	
3	**Building Materials**		8
	3.1	Timber - Types of natural wood and artificial wood, preservative treatments, defects in timber, wood products and wood composites. Plywood, Block board, alternatives, laminates.	
	3.2	Steel - Properties of steel as building material, different types of steel used in construction. Strengthening mechanism in metals. Behavior in service and corrosion. Aluminium and Composites- different uses in construction.	
	3.3	Bricks - Classification, Manufacturing of clay bricks, Requirement of good bricks	
	3.4	Concrete blocks, Paver block, Autoclaved Aerated Concrete (AAC) blocks, Cellular Light Weight Concrete (CLC) blocks and ceramic tiles: raw materials, manufacturing process and properties.	
	3.5	Bitumen/ Asphalt, Polymers and epoxies in construction, Fibre-polymercomposites, Adhesives, Types of external paints.	
4	**Testing Methods, recyclability and Sustainability of Building Materials**		04
	4.1	Field and laboratory tests on bricks: compressive strength, water absorption, efflorescence, dimension and warpage.	
	4.2	Recyclability, Sustainability, Carbon cycle and role of construction material such as concrete and steel, CO_2 contribution from cement and other construction materials.	
5	**Mixers, Vibrators, Lifts and Pumps**		07

	5.1	Mixers: Tilting, Non Tilting and Reversing, Transit Mixers,Maintenance of Mixers	
	5.2	Vibrators: Needle Vibrator, Formwork Vibrator, Table Vibrator, Platform Vibrator, Surface Vibrator and Vibratory Roller.	
	5.3	Pulley blocks, Lifts and conveyors, their components.	
	5.4	Pumps: different types used for buildings, their components	
6	**Excavators, Earthmovers, carriers and Road Rollers**		**04**
	6.1	Types of Excavators, Applications of different types of excavator. Earthmoving equipment, tractors and attachments, dozers and rippers, scrapers, shovels, draglines, trenching machines, clamshell, hoes, dozers, trenching machines.	
	6.2	Tippers, dumpers, tractors, trucks and wagons, Road rollers and compactors.	
		Total	**39**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Develop and implement the knowledge of constituent materials and their composition in concrete and its mix design.
2. Assess of fresh and hardened concrete by conducting tests.
3. Select suitable building materials like brick, timber, steel, concrete blocks and chemicals materials on the basis of its properties.
4. Apply field and laboratory testing for assuring quality of materials and have awareness of recyclability and Sustainability of Building Materials.
5. Employ suitable machinery and equipment for construction activities.
6. Take a call on usage of right type of heavy equipment and vehicles for various construction activities.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number ofrespective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**

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 any module other than module 3).
4. **Only** Four questions need to be solved**.**

Recommended Books:

1. A Building Construction: S.C. Rangwala, Charotar Publications, Gujarat, India.
2. Building Construction: S.P. Arora, Dr.S.P. Bindra, DhanpatRai Publication, New Delhi.
3. Building Construction: Dr. B.C. Punmia, A.K.Jain, A.R.Jain, Laxmi Publication., NewDelhi.
4. Concrete Technology Theory and Practice: M.S. Shetty, S.Chand Publication.
5. Concrete Technology: M.L. Gambhir, Tata McGraw Hill, NewDelhi.
6. Concrete Technology: A.M. Neville & J. J. Brooks., ELBS-Longman.
7. Concrete Technology: A.M. Neville & Isaac Pitman, London.
8. Concrete Technology: A. R. Shanthakumar, Oxford University Press.
9. Materials of Construction: D. N. Ghose, Tata McGraw Hill, Delhi.
10. Building Materials: S.K. Duggal, New Age International Publishers.
11. Construction Planning, Equipment and Methods, Robert Peurifoy, McGraw Hill Education

Reference Books:

1. Engineering Materials: S.R. Rangwala, Charotar Publications.
2. Architectural Materials science: D. Anapetor, Mir Publishers.
3. Introduction to Engineering Materials: B. K. Agrawal, Tata McGraw Hill, NewDelhi.
4. Engineering Materials: P. Surendra Singh, Vani Education Books,New Delhi.
5. Building Materials (Products, Properties and Systems): M.L. Gambhir andNeha Jamwal, McGraw Hill Publications.
6. Properties of concrete: Neville, Isaac Pitman, London.
7. NPTEL Lecture series on Building Materials, Concrete Technology and constructionequipment.
12. 8. Government of India, Ministry of Railways, Compendium of Construction Equipments. https://rdso.indianrailways.gov.in

Semester- IV

Course Code	Course Name	Credits
CIC405	Geotechnics	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	-	-	-	100

Rationale

All civil engineering structures are supported by the earth surface made of soil and rock. The stability of structure depends on the stability of the supporting media. Geology involves the collection, analysis, and Interpretation of geological data and information required for the safe development of civil works. Understanding of the foundation rocks and structures present in them is of utmost importance for the safety and stability of Civil engineering structures. Geotechnical analysis depends on the basic properties of soil and rock, which are useful for determining the strength, compressibility and drainage characteristics. Various test methods on soil and rock and their applicability from the viewpoint of geotechnical engineering will be learnt.

The objective of this course is to focus on the core activities of geologists and Geotechnical engineers like site characterization and geologic hazard identification. Through lectures, labs and case studies students will learn to couple geologic information with the engineering properties of rock civil and infrastructure projects.

Objectives

1. To acquire basic knowledge of Geology and to understand its significance in various civilengineering projects.
2. To study minerals and rocks in order to understand their physical properties like structuralgeology, mineralogy, petrology and stratigraphy.
3. To understand rock mass characterization for site selection of dams and tunnels and assessment of strata for ground water.
4. To study types of soils as well as different physical, hydraulic, compressibility and shearstrength properties of soil.

5. To understand properties of rock and different test methods for their assessment.
6. To understand the techniques of soil exploration, assessing the subsoil conditions and engineering properties of various soil strata and their suitability.

Detailed Syllabus

Module		Course Modules/Contents	Duration
1	**Introduction to Geology, Physical Geology and Principles of Stratigraphy**		7
	1.1	Importance of geology in Civil Engineering, Branches of Geologyuseful to civil engineering	
	1.2	Internal structure of earth and use of seismic waves in understandingthe interior of the earth. Plate tectonics.	
	1.3	Types, factors and significance of weathering	
	1.4	Study of Geological action of wind, river, glacier.	
	1.5	General Principles of Stratigraphy, Geological Time Scale	
2	**Mineralogy, Petrology, Structural Geology and Geological Investigation**		7
	2.1	Mineralogy - Identification of minerals based on physical properties.	
	2.2	Petrology - Mode of formation, Classification, Structure, Texture, Engineering applications of Igneous, Sedimentary and Metamorphic rocks.	
	2.3	Structural geology - Terminology, classification and engineering consideration of fold and faults. Types and geological importance of unconformities and joints.	
	2.4	Geological investigations, drilling, Rock Quality Designation (RQD), Core recovery	
3	**Geological Considerations for Dams and Tunnels, Ground water, Earthquake**		5
	3.1	Required geological consideration for selecting dam and tunnel site. Favorable & unfavorable conditions in different types of rocks in presence of various structural features	
	3.2	Groundwater - Sources, zones, water table, Perched water table. Factors controlling water bearing capacity of rocks, cone of depression. Earthquake- terminology, classification and zones. Precautionary measures.	
4	**Soil Types, Properties and Test Methods**		6
	4.1	Definitions: Soil, Rock, Soil Engineering, Rock Mechanics, Geotechnical Engineering	

	4.2	Soil types based on its origin and mode of; Cohesionless and cohesive soils, Relative density of soil, Relative compaction; Types of clay minerals and basic structures (Kaolinite, Illite, Montmorillonite).	
	4.3	Soil Tests: As per IS code - water content, specific gravity, field density, Atterberg limit tests, Sieve and Hydrometer Analysis, Permeability tests, Standard and Modified Proctor tests, Relative density test, Triaxial and Direct shear tests, Consolidation test, Swelling index test, CBR test.	
5	**Rock Properties and Test methods**		**7**
	5.1	Rock as engineering material, Natural rock environments, Influence of geological factors on rocks and rock masses	
	5.2	Intact rock; Discontinuities and Rock masses (Deformability, Strength, Post-peak strength behavior);	
	5.3	Rock Properties and Tests: Rock core specimen preparation, Common laboratory tests for intact rocks: Strength (Point load index, Compressive strength, Direct tensile strength of intact rock core specimens, Brazilian test, Direct shear test), Deformation and stiffness, Pulse velocities and ultrasonic elastic constants, Creep tests, Permeability and durability.	
6	**Field Investigation/ Soil Exploration**		**7**
	6.1	Necessity of soil exploration, methods of soil investigation, Machines used for exploration in land and in water.	
	6.2	disturbed and undisturbed soil samples, soil sampling and samplers, number and spacing of bore holes, depth of bore holes.	
	6.3	Penetrometer tests and corrections: SPT, SCPT and DCPT; Correlation of bearing capacity of foundations on soil with SPT and CPT values, Representation of data with borehole logs.	
		Total	**39**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Explain the concepts of Geology and its application for safe, stable and economic design of any civil engineering structure.
2. Interpret the lithological characters of the rock specimen and distinguish them on the basis of studied parameters.
3. Describe the structural elements of the rocks and implement the knowledge for collection and analysis of the geological data. Interpret the geological conditions for the dam site and calculate RQD for the assessment of rock masses.
4. Evaluate different properties of soil.
5. Evaluate different properties of rock.

6. Understand the necessity and methods of soil exploration as well as assess the bearing capacity of foundations on soil

Internal Assessment (20Marks):

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

End Semester Examination (80Marks):

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

1. Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module3then part (b) will be from any module other thanmodule3).
4. **Only** Four questions need to be solved**.**

Recommended Books:

1. Text book of Engineering Geology: N. Chenna, Kesavulu, Mc-Millan.
2. Text book of Engineering and General Geology, 8th edition (2010): Parbin Singh, S KKataria & Sons.
3. Text book of Engineering Geology: P. K. Mukerjee, Asia.
4. Text book of Engineering Geology: Dr. R. B. Gupte, Pune Vidyarthi Griha Prakashan,Pune.
5. Principles of Engineering Geology: K. M. Banger.
6. Basic and Applied Soil Mechanics: Gopal Ranjan, A. S. R. Rao; New Age International Publishers
7. Soil Mechanics and Foundation Engineering: K. R. Arora; Standard Publishers and Distributors, New Delhi.
8. Soil Mechanics and Foundations: B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain;Laxmi Publications (P) LTD., New Delhi.
9. Engineering Rock Mechanics: An Introduction to the Principles: John A. Hudson and John P. Harrison; Elsevier Ltd.
10. Fundamentals of Rock Mechanics: John Jaeger, N. G. Cook and Robert Zimmerman; Blackwell Publishing.

Reference Books:

1. Principles of Physical Geology: Arthur Homes, Thomas Nelson Publications, London.
2. StructuralGeology,3rdedition(2010): Marl and P. Billings, PHI Learning Pvt. Ltd. New Delhi
3. Earth Revealed, Physical Geology: David McGeeary and Charles C. Plummer
4. Principles of Geomorphology: William D. Thornbury, John Wiley Publications, New York.

5. Geology for Civil Engineering: A. C. McLean, C.D. Gribble, George Allen & Unwin London
6. Engineering Geology: A Parthsarathy, V. Panchapakesan, R Nagarajan, Wiley India2013
7. Soil Mechanics and Foundation Engineering: V. N. S. Murthy; CBS Publishers & Distributors
8. Soil Mechanics: R. F. Craig; Spon Press, Taylor and Fransis Group
9. Soil Mechanics: T. W. Lambe, R. V. Whitman; John Wiley & Sons
10. Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi

Semester- IV

Course Code	Course Name	Credits
CIL401	Structural Analysis Tutorial	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To analyze for axial force in the Coplanar, perfect trusses and evaluate deflection in trusses using energy methods.
2. To study the concept of Influence Line Diagrams and rolling loads.
3. To understand to differentiate determinate and indeterminate structures.
4. To learn methods for evaluating rotation and displacement of frames and trusses.
5. To analyze the indeterminate structures using Flexibility methods and Stiffness methods.
6. To understand Plastic analysis including plastic hinge and plastic moment capacity.
7.

List of Tutorials and Assignments		
Week (Activity)	Content	Hours
1st week (Tutorial)	Analysis of Trusses. (Numericals based on this Module will be solved in tutorial room.)	2
2nd week (Assignments)	1) Analysis of Trusses 2) Solve set of questions given by the course instructor or 3) Write a report on use of arches in civil engineering or	2

	4) Difference in behaviour of trusses and arches if used in bridges or 5) Write a report on limitations of trusses /arches or 6) Report Famous Truss structures / arch structures in world or 7) Write a report on use of trusses in Civil Engineering	
3rd week (Tutorial)	Influence line diagrams and rolling loads (Numericals based on this Module will be solved in tutorial room.)	**2**
4th week (Assignments)	Influence line diagrams and rolling loads 1) Solve set of questions given by the course instructor or 2) Write a report on use of arches in civil engineering or 3) Design an experiment for ILD of reactions of beam. or 4) Design an experiment for ILD of axial forces of a multi-bay truss.or 5) write a report on IRC and classes of rolling loads	**2**
5th week (Tutorial)	Determinate and Indeterminate structure (Numericals based on this Module will be solved in tutorial room.)	**2**
6th week (Assignments)	Determinate and Indeterminate structure 1) Solve set of questions given by the course instructor or 2) Prepare a chart explaining static and kinematic indeterminacy or 3) Write a computer program in C++ or MS-excel or similar for ILDof reactions. or 4) Write a computer program in C++ or MS-excel or similar forILD for axial forces in Truss members.	**2**
7th week (Tutorial)	Analysis of indeterminate structures by Flexibility method (Numerical based on this Module will be solved in tutorial room.)	**2**
8th week (Assignments)	Analysis of indeterminate structures by Flexibility method 1) Solve set of questions given by the course instructor or 2) Prepare a poster on Flexibility and Stiffness approach or 3) Solve a set of 4-5 questions given by the course instructor on Flexibility methods and validate the same using relevant Structural Analysis or design software.	**2**
9th week (Tutorial)	Analysis of indeterminate structures by Direct stiffness method (Numericals based on this Module will be solved in tutorial room).	**2**
10th week (Assignments)	Analysis of indeterminate structures by slope and deflection method	**2**

	1) Solve set of questions given by the course instructor or 2) Write a report on Stiffness methods in civil engineering or 3) Prepare a poster on Clapeyron's theorem for continuous beam. or 4) Solve a set of 4-5 questions given by the course instructor on direct stiffness method and validate the same using relevant Structural Analysis or design software.	
11th week **(Tutorial)**	Moment distribution method, Plastic analysis of structures (Numerical based on this Module will be solved in tutorial room.)	**2**
12th week **(Assignments)**	Moment distribution method, Plastic analysis of structures 1) Solve set of questions given by the course instructor or 2) Write a report on Plastic analysis of structures or 3) Solve a set of 4-5 questions given by the course instructor on Moment distribution method and validate the same using relevant Structural Analysis or design software.	**2**
13th week	Viva-Voce Examination	**2**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Calculate axial forces in the Coplanar trusses by using Method of joints and method of sections and also calculate deflection in truss at various joints using energy methods.
2. Draw Influence Line Diagrams for axial forces in trusses, Reactions, SF and B M in beams and find their values when rolling loads are passing over them.
3. To compute static and kinematic indeterminacy (degrees of freedom) of the structuressuch as beams & rigid and pin jointed frames.
4. Evaluate rotation and displacement at a joint of frames and deflection at any joint of truss and will be able to compute static and kinematic indeterminacy of structure.
5. Analyze the indeterminate structures such as beams & simple rigid jointed frames using Flexibility methods and direct stiffness method.
6. Evaluate the behaviour of various statically indeterminate beams under plastic state.

Assessment:

Term Work:

Term work will include Tutorial work and Assignments both, Distribution of marks for TermWork shall be as follows:

Tutorial work-	:	15 Marks
Assignments-	:	10 Marks
Total Term work	:	25 Marks

Attendance : Apply multiplying Factor 0.5 to 1.0 to the above total.

End Semester Oral Examination

Oral examination will be based on entire syllabus.

Recommended Books:

1. Basic Structural Analysis: C. S. Reddy, Tata McGraw Hill NewDelhi.
2. Mechanics of Structures: Vol-I: S. B. Junnarkar and H.J.Shah, Charotar Publishers, Anand.
3. Analysis of Structures: Vol.I and II, Vazirani and Ratwani.
4. Strength of Materials: S. Ramamrutham, Dhanpatrai and Publishers, Delhi
5. Theory of Structures: S. Ramamrutham, Dhanpatrai and Sons, Delhi
6. Structural AnalysisI: Hemant Patil, Yogesh Patil, Jignesh Patel, Synergy Knowledge ware,Mumbai.
7. Elementary Structural Analysis: Jindal
8. Structural Analysis: L.S. Negi and R. S. Jangid, TataMc-Graw Hill India
9. Structural Analysis: T.S. Thandavamoorthy, Oxford University Press.
10. Structural Analysis: Manmohan Das, BharghabMohan Pentice Hall International.

Reference Books:

1. Structural Analysis: Hibbler, Pentice Hall International.
2. Structural Analysis: Chajes, ElBS London.
3. Theory of Structures: Timoshenko and Young, Tata Mc Graw Hill NewDelhi.
4. Structural Analysis: Kassimali, TWS Publications.
5. Element of Structural Analysis: Norrisand Wilbur, McGraw Hill.
6. Structural Analysis: Laursen H.I, McGraw Hill Publishing Co.
7. Structural theorem and their application :B.G.Neal, PergamanPress.
8. Elementary theory of Structures: Hseih, PrenticeHall

Semester- IV

Course Code	Course Name	Credits
CIL402	Town and Country Planning	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To remember and recall the intricate details of basic requirements for Town & Country Planning.
2. To understand the preparation of drawings for Town/District in terms of all basic Infrastructure.
3. To learn how to apply professional ethics and act responsibly pertaining to the norms of building Planning, design and drawing practices, rules, regulation and byelaws, Building codes
4. To identify, analyze, research literate and solve Town design and preparing drawings as a whole. To have innovative solutions for complex planning & design of Towns & small regions in a district.
5. To effectively communicate ideas, related to drawings prepared, both orally as well as in written format like reports & drawings for small& big Cities.
6. To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

Practical:

Students should make all the drawings during the Practical time allotted to them.

1. Drawings (Manually) should be drawn in the allotted Drawing hall only.
2. Drawings (CAD sheets) should be drawn on the Desktop/Laptop in Computational Lab. After completing the work, print out of those sheets should be submitted for gradation/Marks.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Learn to apply the planning for Residential buildings/ Apartments/ Townships/ Neighborhood.
2. Understand the basic concepts of innovation in planning Towns & Villages.
3. Learn how to apply professional ethics and act responsibly pertaining to the norms of Town Planning and drawing practices.
4. Identify, analyze, research literate and solve complex issues related to drawings of Towns & Villages.
5. Have new innovative solutions for complex issues like Master Plan & Regional Plan.
6. To effectively communicate ideas related to drawings prepared, both orally as well as in written format like reports & drawings for small& big Cities.

Assignments:

Two Assignments should be completed, covering all the modules in the syllabus.

1. Assignment-1 should be on 50% of the syllabus, to be completed before Internal Assessment-I exam.
2. Assignment-2 should be on the remaining 50% of the Syllabus, to be completed before Internal Assessment-II exam.

Site Visit:

Students should visit any Residential Township/Neighborhood of Buildings physically and take Measurements inside of all rooms & over all outside of the building & can submit a small Drawing sheet with the help of CAD. (**Optional** only)

Practical Examination (Oral and Sketching):

Practical examination will consist of sketching and oral examination based on the entire syllabus.

Term Work:

Drawings & Assignments:

1. (Approval Drawing) Ground floor plan, First floor plan, elevation, section passing throughat least one sanitary unit & staircase, and construction notes of a residential building bungalow or apartment to be constructed as a (G+1) R.C.C. framed structure(only ManualDrawing)
2. Residential Township Drawing (Manual/CAD based)
3. Neighborhood planning of Residencies in a Town (CAD based drawing)
4. Preparation Master Plan of a small TOWN, with all Infrastructural facilities(Manual)
5. Preparation of a REGIONAL PLAN for a small area in District (CAD based)
6. Assignment - 1 Electrical Drawing, HVAC drawing.
7. Assignment - 2 Water supply and Plumbing drawing.

Distribution of Term-work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification acceptance of term-work warrants the satisfactorily the appropriate completion of the required quality & quantity of work for the minimum passing marks to be obtained by the students. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

Particulars	**Marks**
1. 4 Drawing Sheets (Manual)	**7.5** Marks
2. 4 Drawing Sheets (**CAD** Based)	**7.5** Marks
3. Assignments	**5** Marks
4. Attendance (Theory &Practical)	**5** Marks
Total	**25 Marks**

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to. 75% 80%: 03 Marks; 81% 90%: 04 Marks 91% onwards: 05 Marks **(Consider Practical attendance)**

Semester- IV

Course Code	Course Name	Credits
CIL403	Concrete Technology, Building Materials and Construction Equipment (LAB)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	25	-	50

Objectives

1. To determine physical and mechanical properties of materials used in the manufacturing of concrete like cement and aggregates.
2. To test the physical attributes and mechanical strength of burnt clay bricks used in the construction of structures.
3. To determine the various properties of fresh and hardened concrete with and without the addition of admixtures
4. To utilize the knowledge of mix design in the manufacturing of concrete, in the laboratory
5. To test the physical attributes and mechanical strength of timber and tiles used inthe construction of various components of the structure.
6. To understand the practical scenario of the commonly used building materials in terms of their availability, cost and significance through market surveys

List of Experiments

(First four compulsory and any four from remaining)

Module	Detailed Content	Lab Session / Hr.
1	Testing of Cement: Consistency, fineness, setting time, Specific Gravity, Soundness and strength.	02/04
2	Physical Properties of Fine and Coarse Aggregates: Specific	02/04

	gravity, bulk density, Moisture content, Water absorption, flakiness index, elongation index, Fineness modulus, Silt content and bulking of sand	
3	Effect of w/c ratio on workability (slump cone, compaction factor, V-B test, flow table) and strength of concrete	**02/04**
4	Study of admixtures and their effect on workability and strength of concrete.	**01/02**
5	Tests on burnt clay bricks	**01/02**
6	Market survey on common building materials	**01/02**
7	Market survey on trending earthmovers/ excavators/ dumpers/ compactors.	**01/02**
8	Test on tiles	**01/02**
9	Compression test on timber (Parallel/ perpendicular to the grains).	**01/02**
10	Testing on flexibility of paint.	**01/02**

Site Visit/ Industrial Visit:

The students shall visit the brick manufacturing unit, concrete block, cement and RMC industrial plants. They shall prepare a report of the visit and the same shall be evaluated by the concerned teacher.

Contribution to Outcomes

At the end of the course, learner will be able:

1. To prepare the students to effectively link theory with practice and application and to demonstrate background of the theoretical aspects.
2. To test physical properties of cement, aggregates and concrete.
3. To test physical properties of cement, aggregates and concrete.
4. To evaluate the effects of admixtures on physical properties of concrete.
5. To design the concrete mix.
6. To bridge the gap between theoretical and market/industrial practices by marketsurveys.

Assessment:

The term work shall consist of:

- Report of experiments performed.
- Industrial visit report to at least any one of the above mentioned industrial plants.

- Although minimum numbers of market surveys and industrial visits are prescribed, the students shall be encouraged to perform more number of experiments and site/ industrial visits.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work including industrial/ site visit report. The final certification and acceptance of term work warrants the satisfactory performance of laboratory work by the student, appropriate completion of the assignments. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

Individual Practical performance	:	07 Marks
Assignments	:	03 Marks
Reports of experiment	:	05 Marks
Site Visit/Industrial visit	:	05 Marks
Attendance	:	05 Marks
Total	:	**25 Marks**

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted

75% - 80%: 03 Marks; 81% - 90%: 04 Marks; 91% onwards: 05 Marks.

End Semester Practical/Oral Examination

The oral examination shall be based on the entire syllabus and term work comprising of the report of the experiments/ practical conducted by the students and a detail report of theindustrial/ site visit.

Semester- IV

Course Code	Course Name	Credits
CIL404	Geotechnics (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
-	02	-	-	01	-	01

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Objectives

1. To acquire basic knowledge of Geological Lab practices and apply it for the safe development of Civil Engineering works.
2. To examine the mineral and rock sample and understand their fundamental properties for their evaluation as construction and foundation material.
3. To study the concept of Influence Line Diagrams and rolling loads.
4. To study the Geological maps and their sections in terms of selecting the sites for various civil engineering structures.
5. To study various properties of soil.
6. To study various properties and test on rocks.

List of Experiments		
Sr. No	Content	Hours
1	**Study of Physical Properties of Minerals:** Identification of common Rock forming minerals on the basis of physicalProperties-	2

	Silica Group: Quartz and its varieties; Cryptocrystalline silica: Jasper and Agate; **Feldspar Group:** Orthoclase, Plagioclase; **Carbonate Group:** calcite; **Amphibole Group:** Asbestos, Actinolite and Hornblende; **Pyroxene Group:** Augite; **Mica Group:** Muscovite, Biotite and Talc; **Element Group:** Graphite.	
2	Identification of Metallic minerals: Galena, Pyrite, Hematite, Magnetite.	**1**
3	**Identification of rocks:** **Igneous Rocks**-Granite and its varieties, Syenite, Diorite, Gabbro, Pegmatite. Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic Tuffs.	**2**
4	**Sedimentary Rocks-** Conglomerate, Breccia, Sandstone and its varieties, Shales, Limestones, Laterites.	**2**
5	**Metamorphic Rocks**-Schist and its varieties, Gneiss and its varieties, Slate, Marbles, Quartzite and Phyllite.	**2**
6	**Geological Maps:** 1. Horizontal strata: Drawing the cross section and assessment of geological history of the area. 2. Inclined Strata: Calculation of dip and strike in an inclined strata and assessment of geological history of the area. 3. Assessment of the geological conditions for a proposed dam and tunnel site in the given map. 4. Assessment of the geological conditions for groundwater reserve in the given map.	**4**
7	Determination of natural moisture content of soil using oven drying method	**1**
	Specific gravity of soil grains by density bottle method or Pycnometer method.	**1**
	Field density of soil using core cutter and sand replacement methods	**1**
8	Grain size distribution of coarse-grained portions (gravel and sand) of soil by sieve analysis	**1**
9	Grain size distribution of fine portions (silt and clay) of the soil by Hydrometer analysis	**1**
	Determination of liquid, plastic and shrinkage limits of soil	**1**
	Determination of co-efficient of permeability of soil	**1**
	IS light and heavy compaction tests on soil	**1**
	Relative density (or, density index) test on soil	**1**
10	Point load strength index test on rock	**1**

	Brazilian test to obtain tensile strength of rock	**1**
	Compressive strength test on intact rock specimen	**1**
	Direct shear test on intact rock specimen	**1**
11	Demonstration of Core box with the bore log in Lab or construction site	**1**

Contribution to Outcomes

On completion of this course, the students will be able to:

1. Identify various rock forming minerals on the basis of physical properties.
2. Explain the characteristics of Igneous, Sedimentary and Metamorphic rocks and assess their suitability as construction material and foundation rock.
3. Interpret the rock characteristics and comment on their suitability as water bearing horizons.
4. Interpret the geological map and assess the suitability of the site for Civil Engineering works.
5. Understand and explain various properties of soil.
6. Understand and explain various properties and test on rocks.

Assessment:

Term Work:
Term work will include Lab work and Assignments. Journal for lab work for 10 marks will be prepared as per course instructor‘s instructions (not more than 25 pages).

Distribution of marks for Term Work shall be as follows:Laboratory work - : 10Marks
Assignments- : 10Marks
Attendance : 05Marks

End Semester Oral Examination
Oral examination will be based on entire syllabus

Semester- IV

Course Code	Course Name	Credits
CIL405	Skill Based Lab Course –II	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	-	50

Objectives

1. To provide the hands-on training of the software and to understand various functions
2. To use and apply various functions of the software in the field of civil engineering
3. To prepare the database and to perform statistical analysis
4. To prepare the industry approved laboratory test results using tools of the software
5. To design the reliable structural members using various tools and functions
6. To apply the knowledge to create the programme related to various streams of civil engineering

List of Experiments (Minimum Eight)		
Module	**Detailed Content**	**Lab Session / Hr.**
1	**Introduction to excel** **Exp 1**: Introduction to excel, importance of excel in civil engineeringfield	**3**
2	**Basic functions of Microsoft excel** Hands on training on utilization of various tools to be used for civil engineering applications	**6**
	Exp 2: Basic functions and tools in excel	

3	**Database management using excel** Basic functions required for preparation of database, statistical analysisof data, graphical representation of data **Exp 3**: Creation of data for any of the civil engineering stream Graphical representation of data Eg. Traffic volume survey data and its analysis and representation	**6**
4	**Analysis of laboratory data in excel** Preparation of laboratory reports using excel, using various functionsof excel for preparation of laboratory results in standard format, presentation of test reports in graphical format **Exp 4**: Preparation of test report of laboratory material testing	**3**
	Exp 5: Preparation of test report for geotechnical laboratory testing	**3**
5	**Design of structural member using excel** **Exp 6**: Design of structural members using various functions of excel	**6**
6	**Programming using excel** Preparation of programme using various functions of excel for civil orrelevant field **Exp 7**: Preparation of mix design	**3**
	Exp 8: Design of pavement	**3**
	Exp 9: Preparation of resource allocation profiles	**3**
	Exp 10: Preparation of RA bills of contractor	**3**

Contribution to Outcomes

At the end of the course, learner will be able:

1. To understand the functions involved in excel
2. Apply the various functions in excel for solving problems related to civil engineeringfield
3. To perform different functions of the software related to creation of database and its analysis.
4. To describe and represent the data obtained from site, experimental work in various formats as per industrial requirements
5. To design the structural members using various functions in excel
6. To apply the knowledge to create the programme in excel and for solving problems pertaining to civil engineering field.

Assessment:

Term Work

Including Laboratory Work comprising of minimum 6 software generated reports/sheets/program outputs with one walkthrough presentation on MS Excel, distribution of marks for Term Work shall be as follows:

Laboratory Work	:	30 Marks (comprising of minimum 6 software generated sheets)
Presentation	:	10 Marks
Attendance	:	10 Marks

Reference Books:

1. Software manuals
2. Refereed Journal papers on Software applications

Semester- IV

Course Code	Course Name	Credits
CIM401	Mini Project-1B	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	25	-	25	50

Rationale

Civil and infrastructure engineers deal with many challenges on daily basis. The civil engineering industry's growth has been need based and society centric. Electronics systems, Computers and IT systems have touched almost every part of our lives and inter-disciplinary approach is way of life ahead.

Mumbai University proposed Mini projects in the syllabus so that the budding civil engineers can connect with the world outside their textbooks and have the idea of future course. The Mini project should actually provide solution to a typical problem after a brainstorming and in a stipulated period. The competitions ahead will give students the experience of the civil engineering industry's real-world problems and make students brainstorm ideas, learn, and explore the civil engineering industry

Objectives

1. To recognize societal problems and convert them into a problem statement by understanding of facts and ideas in a group activity.(BTL-2)
2. To deal with new problems and situations by applying acquired knowledge, facts, techniques and rules in a different way. (BTL-3)

3. To examine and break information into parts, by analyzing motives or causes. (BTL-4)
4. To learn evaluating information, validity of ideas and work based on a set of criteria. (BTL-5)
5. To create solutions by compiling information together in a novel way.(BTL-6)
6. To design software based model, application or IT system by combining elements in a new pattern or proposing new solutions. (BTL-6)

Guidelines for Mini Project - 1B

- 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 find ‗List of Mini project- 1B problems' in University web portal www.mu.ac.in, and in consultation with faculty supervisor/head of department/internal committee of faculties select the title.
- Students shall submit implementation plan in the form of Gant/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 A computerized Model/ software/ A computer program, an IOT application or A Computer or Mobile based application using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled instandard 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 Students come out with original solution.

- 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 workon 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 casebasis.

Contribution to Outcomes

Learner will be able to…

1. **Identify** problems based on societal/research needs and formulate a solution strategy.
2. **Apply** fundamentals to develop solutions to solve societal problems in a group.
3. **Analyze** the specific need, formulate the problem and deduce the interdisciplinary approaches, software based solutions and computer applications.
4. Develop systematic flow chart, **evaluate** inter disciplinary practices, devices, available software, estimate and recommend possible solutions.
5. Draw the proper inferences from available results through theoretical/experimental/simulations and **assemble** physical systems.
6. **Create** devises or design a computer program or develop computer application

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

Assessment criteria of Mini Project -1B.

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. Effective use of standard engineering norms
10. Contribution of an individual‘s as member or leader
11. 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 organizations 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