R20 COURSE STRUCTURE AND SYLLABUS

For

B. Tech.

CIVIL ENGINEERING

(*Applicable for batches admitted from 2020-21*)

PRAGATI ENGINEERING COLLEGE

(AUTONOMOUS)

Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with "A" Grade
Recognized by UGC 2(f) and 12(b) under UGC act, 1956
1-378, ADB Road, Surampalem – 533 437 NearPeddapuram, E.G.Dist, Andhra Pradesh

Vision of the Department

Impart ethical technical knowledge of global standards in the field of Civil Engineering in order to meet new challenges in Professional and Research Environment.

Mission of the Department

- To train professionals in the field of Civil Engineering, who can contribute to the Industry, Research & Development and also shoulder the social responsibility.
- To provide state of art resources that contribute to congenial learning environment.
- To encourage faculty and students to pursue higher education and various career enhancing courses.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will excel as successful Civil Engineers, Academicians and Researchers.

PEO2: Graduates of the programme will continue to engage in lifelong learning, possess good communication skills, managerial skills, team work and social responsibility while exhibiting ethical attitude.

PEO3: Graduates of the programme will explore and apply the modern Engineering tools for Planning and Designing of various Civil Engineering projects that are technically and economically viable.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:**Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- **PSO1:** Students will be able to Plan, Survey, Estimate and Execute various Civil Engineering Projects.
- **PSO2:** Students will be able to Design Sub-Structure, Super-Structure and Pavements.
- **PSO3:** Students will be able to apply the techniques for design of various Water front structures and solving the various Environmental issues.

AUTONOMOUS COLLEGES OF JNTUK
COMMON ACADEMIC REGULATIONS (R20) FOR B. TECH PROGRAMME
(Applicable for from the Academic Year 2020-21)

1. Award of B. Tech. Degree

(a) A student will be declared eligible for the award of B. Tech. Degree if he fulfils the following academic regulations:
   (i) A student shall be declared eligible for the award of B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall **forfeit** their seat in B. Tech course and their admission stands cancelled.
   (ii) The candidate shall register for 160 credits and secure all the 160 credits.

(b) The medium of instruction for the entire under graduate programme in Engineering & Technology will be in **English** only.

2. Programme Pattern:

a) Total duration of the of B. Tech (Regular) Programme is four academic years
b) Each Academic year of study is divided into **Two Semesters**.
c) Minimum number of instruction days in each semester is 90.
d) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
e) The total credits for the Programme is 160.
f) Three week induction program is mandatory for all first year UG students and shall be conducted as per AICTE/UGC/APSCHE guidelines.
g) Student is introduced to "Choice Based Credit System (CBCS)".
h) A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)
i) A student has to register for all courses in a semester.
j) All the registered credits will be considered for the calculation of final CGPA.
k) Each semester has - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.
l) A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and make engineering graduates to connect with the needs of the industry and society at large.
m) All the students shall be mandatorily registered for NCC, NSS activities and Community Service Project as per the Government and University norms.
n) Each college shall assign a faculty advisor/mentor after admission to each student or group of students from same department to provide guidance in courses registration/career growth/placements/opportunities for higher studies/GATE/other competitive exams etc.

3. Registration for Courses:

a) In each semester a student shall mandatorily register courses which he/she wishes to pursue within a week from the starting of the class work with the advice of Head of the Department and mentor ofthe student of the concerned department of the college.
b) If any student wishes to withdraw the registration of the course, he/she shall submit a letter to the Principal of the college through the Head of the Department and mentor within fifteen days.

c) The concerned college shall thoroughly verify and upload the data/courses registered by each student in the university examination center within 20 days. The Principal of the concerned college shall ensure that there no wrong registration courses by the student. The university registration portal will be closed after 20 days.

4. (a) Award of B. Tech. Degree: A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

i. A student shall be declared eligible for award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall **forfeit** their seat in B. Tech course and their admission stands cancelled.

ii. The student shall register for 160 credits and must secure all the 160 credits.

iii. All students shall mandatorily register for the courses like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure at least 40% of the marks allotted in the internal evaluation for passing the course and shall maintain 75% of attendance in the subject.

iv. All students shall mandatorily register for NCC/NSS activities and will be required to participate in an activity specified by NSS officer during second and third semesters. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behavior. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

v. Credits are defined as per AICTE norms.

(b) Award of B. Tech. (Honor)/B. Tech. (Minor): B. Tech. with Honors or a B. Tech. with a Minor will be awarded if the student earns 20 additional credits are acquired as per the regulations/guidelines. The regulations/guidelines are separately provided. Registering for an Honors/Minor is optional.

5. Attendance Requirements

a) A student is eligible to write the University examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) may be granted by the College Academic Committee. However, this condonation concession is applicable only to any two semesters during the entire programme.

c) Shortage of Attendance below 65% in aggregate shall not be condoned.

d) A student who is short of attendance in a semester may seek re-admission into that semester when offered within 4 weeks from the date of commencement of class work.

e) Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

f) A stipulated fee of Rs. 500/- in the concerned semester shall be payable towards condonation of shortage of attendance. Students availing condonation on medical ground shall produce a medical certificate issued by the competitive authority.

g) A student will be promoted to the next semester if he satisfies the (i) attendance requirement of the present semester and (ii) minimum required credits.

h) If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

i) For induction programme attendance shall be maintained as per AICTE norms.

j) For non-credit mandatory courses the students shall maintain the attendance similar to credit courses

6. Evaluation-Distribution and Weightage of marks

(i) Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the University Examination section from time to time.

(ii) To maintain the quality, external examiners and question paper setters shall be selected from reputed institutes like IISc, IITs, IIITs, IISERs, NITs and Universities.

(iii) For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the

marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

(iv) A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/ project etc by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the sum total of the internal marks and end semester examination marks together.

(v) Distribution and Weightage of marks:

The assessment of the student's performance in each course will be as per the details given:

S. No	Components	Internal	External	Total
1	Theory	30	70	100
2	Engineering Graphics/Design/Drawing	30	70	100
3	Practical	15	35	50
4	Mini Project/Internship/Industrial Training/ Skill Development programmes/Research Project	-	50	50
5	Project Work	60	140	200

(vi) Continuous Internal Theory Evaluation:

a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (20 multiple choice questions) for 10 marks for a duration of 20 minutes (ii) one descriptive examination (3 full questions for 5 marks each) for 15 marks for a duration of 90 minutes and (iii) one assignment for marks. All the internal exams shall be conducted as per university norms from first 50% of the syllabi.

b) In the similar lines, the second online, descriptive examinations assignment shall be conducted on the rest of the 50% syllabus.

c) The total marks secured by the student in each mid-term examination are evaluated for 30 marks. The first mid marks (Mid-1) consisting of marks of online objective examination, descriptive examination and assignment shall be submitted to the University examination section within one week after completion of first mid examination.

d) The mid marks submitted to the University examination section shall be displayed in the concerned college notice boards for the benefit of the students.

e) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of university examination section within one week from the submission.

f) Second mid marks (Mid-2) consisting of marks of online objective examination, descriptive examination and assignment shall also be submitted to University examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of university examination section within one week from the submission.

g) Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam.

Example:

Mid-1 marks = Marks secured in (online examination-1+descriptive examination-1 +one assignment-1)

Mid-2 marks = Marks secured in (online examination-2+descriptive examination-2 +one assignment-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 **+ Least of (Mid-1/Mid-2) marks x 0.2)**

h) With the above criteria, university examination section will send mid marks of all subjects in consolidated form to all the concerned colleges and same shall be displayed in the concerned college notice boards. If any discrepancy found, it shall be brought to the notice of university examination section through proper channel within one week with all proofs. Discrepancies brought after the given deadline will not be entertained under any circumstances.

(vii) Semester End Theory Examinations Evaluation:

a) The semester end examinations will be conducted university examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b) For practical subjects there shall be continuous evaluation during the semester for 15 internal marks and 35 end examination marks. The internal 15 marks shall be awarded as follows: day to day work - 5 marks, Record-5 marks and the remaining 5 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner appointed.

c) For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester for 15 marks each and final marks can be calculated with 80% weightage for better of the two tests and 20% weightage for other test and these are to be added to the marks obtained in day to day work.

d) Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme. Students shall pursue this course during summer vacation just before its offering as per course structure. The minimum duration of this course is at least 6 weeks. The student shall register for the course as per course structure after commencement of academic year. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the University. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department. A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the University.

e) The job oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the job oriented skill courses.

f) Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the college internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

g) **Procedure for Conduct and Evaluation of MOOC:** There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint

one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be pass.

h) *Major Project (*Project - Project work, seminar and internship in industry):
In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.
Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 140 marks.

7. Results Declaration:
(i) Before results declaration, an academic council meeting shall be conducted and results shall be placed before the academic council for approval.
(ii) With the approval of academic council, the results shall be submitted to the University to get the approval from Honorable Vice-Chancellor.
(iii) The University may normalize the result, if required, before declaration of the result (Guidelines for normalization will be provided separately)
(iv) A copy of approved results in a CD shall be submitted to the University examination Center.

8. Academic Audit: Academic audit in each semester will be conducted as per norms.

9. Recounting or Re-evaluation of Marks in the End Semester Examination: A student can request for recounting of revaluation of his/her answer book on payment of a prescribed fee as per university norms.

10. Supplementary Examinations: A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the University.

11. Malpractices in Examinations: Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the University.

12. Promotion Rules
The following academic requirements have to be satisfied in addition to the attendance requirementsmentioned in item no.5 for promotion to higher classes

a) A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement as per University norm.
b) A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.
c) A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

13. Course Pattern
a) The entire course of study is for four academic years; all years are on semester pattern.

b) A student eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.
c) When a student is detained for lack of credits / shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

14. Earning of Credit:

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range A+ to E as given below. Letter grade 'F' in any course implies failure of the student in that course and no credits earned. Absent is also treated as no credits earned. For project same % percentages will be followed for grading.

Marks Range Theory (Max – 100)	Marks Range Lab (Max – 50)	Level	Letter Grade	Grade Point
≥ 90	≥ 45	Outstanding	A+	10
≥80 to <89	≥40 to <44	Excellent	A	9
≥70 to <79	≥35 to <39	Very Good	B	8
≥60 to <69	≥30 to <34	Good	C	7
≥50 to <59	≥25 to <29	Fair	D	6
≥40 to <49	≥20 to <24	Satisfactory	E	5
<40	<20	Fail	F	0
-		Absent	AB	0

15. Award of Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥ 7.75 (Without any supplementary appearance)	From the CGPA secured from 160 Credits
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	
Pass Class	≥ 5.00 to < 5.75	

16. Minimum Instruction Days

The minimum instruction days for each semester shall be 90 working days. There shall be no branch transfers after the completion of the admission process. There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.

17. Withholding of Results

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

18. Transitory Regulations

a) Discontinued or detained candidates are eligible for re-admission as and when next offered.
b) The re-admitted candidate will be governed by the rules & regulations under which the candidate has been admitted.
c) (i) In case of transferred students from other Universities, credits shall be transferred to JNTUK as per the academic regulations and course structure of JNTUK.
d) The students seeking transfer to colleges affiliated to JNTUK from various other Universities / Institutions have to obtain the credits of any equivalent subjects as prescribed by JNTUK. In addition, the transferred candidates have to pass the failed subjects at the earlier Institute with already obtained internal/sessional marks to be conducted by JNTUK.

19. Gap - Year

Gap Year concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I/II/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at university level shall be constituted to evaluate the proposal submitted by thestudent and the committee shall decide on permitting the student for availing the Gap Year.

20. General

a) Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

b) The academic regulation should be read as a whole for the purpose of any interpretation.

c) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

d) The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

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ACADEMIC REGULATIONS (R19) FOR B. TECH. (LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. from the Academic Year 2020-21 onwards

1 **Award of B. Tech. Degree**

A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

a) A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years. After six academic years from the year of their admission, he/she shall **forfeit** their seat in B. Tech course and their admission stands cancelled.

b) The candidate shall register for 121 credits and secure all the 121 credits.

2. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech (lateral entry).

3. Promotion Rules

A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

4. Award of Class

After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥ 7.75 (Without any supplementary appearance)	From the CGPA secured from 121 Credits from II Year to IV Year
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	
Pass Class	≥ 5.00 to < 5.75	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

5. All the other regulations as applicable to **B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)**

COMMUNITY SERVICE PROJECT

Introduction

1. Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
2. Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
3. Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigencywhen students cannot pursue their summer internships. The specific objectives are;

1. To sensitize the students to the living conditions of the people who are around them,
2. To help students to realize the stark realities of the society.
3. To bring about an attitudinal change in the students and help them to develop societal consciousness,sensibility, responsibility and accountability
4. To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
5. To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
6. To help students to initiate developmental activities in the community in coordination with public andgovernment authorities.
7. To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

1. Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation.
2. Each class/section should be assigned with a mentor.
3. Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of peoplelike - youth, women, house-wives, etc
4. A log book has to be maintained by each of the student, where the activities undertaken/involved tobe recorded.
5. The log book has to be countersigned by the concerned mentor/faculty in charge.
6. Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
7. The final evaluation to be reflected in the grade memo of the student.
8. The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
9. Minor project report should be submitted by each student. An internal Viva shall also be conductedby a committee constituted by the principal of the college.
10. Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

1. A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable themto commute from their residence and return back by evening or so.

2. The Community Service Project is a twofold one –

a) First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.

b) Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –

- Agriculture
- Health
- Marketing and Cooperation
- Animal Husbandry
- Horticulture
- Fisheries
- Sericulture
- Revenue and Survey
- Natural Disaster Management
- Irrigation
- Law & Order
- Excise and Prohibition
- Mines and Geology
- Energy
- Internet
- Free Electricity
- Drinking Water

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

Learning Outcomes

1. Positive impact on students' academic learning
2. Improves students' ability to apply what they have learned in "the real world"
3. Positive impact on academic outcomes such as demonstrated complexity of understanding,problem analysis, problem-solving, critical thinking, and cognitive development
4. Improved ability to understand complexity and ambiguity

Personal Outcomes

1. Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
2. Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

1. Reduced stereotypes and greater inter-cultural understanding
2. Improved social responsibility and citizenship skills
3. Greater involvement in community service after graduation

Career Development

1. Connections with professionals and community members for learning and career opportunities
2. Greater academic learning, leadership skills, and personal efficacy can lead to greateropportunity

Relationship with the Institution

1. Stronger relationships with faculty
2. Greater satisfaction with college
3. Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

1. Satisfaction with the quality of student learning
2. New avenues for research and publication via new relationships between faculty and community
3. Providing networking opportunities with engaged faculty in other disciplines or institutions
4. A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

1. Improved institutional commitment
2. Improved student retention
3. Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

1. Satisfaction with student participation
2. Valuable human resources needed to achieve community goals
3. New energy, enthusiasm and perspectives applied to community work
4. Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Floury culture
28. Access to safe drinking water

29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilization of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

Complimenting the community service project, the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programmes are;

Programmes for School Children

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

Programmes for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Womens' Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharat
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programmes on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programmes for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programmes

1. Awareness on RTI
2. Health intervention programmes
3. Yoga

4. Tree plantation
5. Programmes in consonance with the Govt. Departments like –
    i. Agriculture
    ii. Health
    iii. Marketing and Cooperation
    iv. Animal Husbandry
    v. Horticulture
    vi. Fisheries
    vii. Sericulture
    viii. Revenue and Survey
    ix. Natural Disaster Management
    x. Irrigation
    xi. Law & Order
    xii. Excise and Prohibition
    xiii. Mines and Geology
    xiv. Energy

Role of Students:

1. Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
2. For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
3. As and when required the College faculty themselves act as Resource Persons.
4. Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
5. And also, with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
6. An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. **Preliminary Survey (One Week)**
    a) A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
    b) A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
    c) The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.
2. ***Community Awareness Campaigns (Two Weeks)***
    Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.
3. ***Community Immersion Programme (Four Weeks)***
    Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

4. Community Exit Report (One Week)

During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action and impose suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
   - (i) A show because notice shall be issued to the college.
   - (ii) Impose a suitable fine on the college.
   - (iii) Shifting the examination centre from the college to another college for a specific period of not less than oneyear.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India
For Constituent Colleges and Affiliated Colleges of JNTUK

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I YEAR I SEMESTER							
S. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	T	P	C
1	Basic Science course	20BM1T01	Differential Equations and Numerical Methods	3	0	0	3
2	Basic Science course	20BP1T01	Engineering Physics	3	0	0	3
3	Humanities and Social science	20HE1T01	Professional Communicative English	3	0	0	3
4	***Engineering Science Courses**	20ME1T01	Engineering Mechanics	3	0	0	3
5	Engineering Science Courses	20EE1T01	Basic Electrical and Electronics Engineering	3	0	0	3
6	Humanities and Social science LAB	20HE1L01	Professional Communicative English Laboratory	0	0	3	1.5
7	Basic Science course (LAB)	20BP1L01	Engineering Physics Laboratory	0	0	3	1.5
8	Engineering Science Courses (LAB)	20EE1L01	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
			Total credits				**19.5**

I YEAR II SEMESTER							
S.No.	**Category**	**Code**	**Course Title**	**Hours perweek**			**Credits**
				L	**T**	**P**	**C**
1	Basic Science Courses	20BM2T02	Linear Algebra and Partial Differential Equations	3	0	0	3
2	Basic Science Courses	20BC2T01	Engineering Chemistry	3	0	0	3
3	Engineering Science Courses	20CS2T01	Programming for problem solving using C	3	0	0	3
4	Engineering Science Courses	20ME2T02	Engineering Drawing	1	0	4	3
5	Engineering Science Courses	20CE2T01	Strength of materials	3	0	0	3
6	Engineering Science Courses (Lab)	20CS2L01	Programming for problem solving using C Laboratory	0	0	3	1.5
7	Basic Science Course (Lab)	20BC2L01	Engineering Chemistry Laboratory	0	0	3	1.5
8	Engineering Science Courses (Lab)	20ME2L01	Engineering Workshop Laboratory	0	0	3	1.5
	Mandatory Course (AICTE Suggested)	20BE2T01	Environmental Science	2	0	0	0
			Total credits				**19.5**

II YEAR I SEMESTER							
S.No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	Basic Science Courses	20BM2T02	Transforms and Vector Calculus	3	0	0	3
2	Professional Core Course	20BC2T01	Solid Mechanics	3	0	0	3
3	Professional Core Courses	20CS2T01	Fluid Mechanics	3	0	0	3
4	Professional Core Courses	20ME2T02	Building Materials and Concrete Technology	3	0	0	3
5	Professional Core Courses	20CE2T01	Surveying	3	0	0	3
6	ProfessionalCoreCourses(Lab)	20CS2L01	Strength of Materials Laboratory	0	0	3	1.5
7	ProfessionalCoreCourses(Lab)	20BC2L01	Surveying Field-work Laboratory	0	0	3	1.5
8	ProfessionalCoreCourses(Lab)	20ME2L01	Building Planning &Drawing Laboratory	0	0	3	1.5
	Skill Oriented Course*	20BE2T01	Total station lab	**1**	**0**	**2**	**2**
	Mandatory Course (AICTE suggested)	20BM2T02	Constitution of India	2	0	0	0
			Total credits				**21.5**

II YEAR II SEMESTER							
S.No	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	**C**
1	Engineering Science Courses	20CE4T06	Engineering Geology	3	0	0	3
2	Basic Science Course / Prof Core Course	20BM4T04	Complex Variables & Statistical Methods	3	0	0	3
3	Professional Core Courses	20CE4T07	Hydraulics & Hydraulic Machinery	3	0	0	3
4	Professional Core Courses	20CE4T08	Structural Analysis	3	0	0	3
5	Humanities and Social Sciences	20HM4T01	Managerial Economics and Financial Analysis	3	0	0	3
6	Engineering Science Courses/Prof Core	20CE4L04	Engineering Geology Laboratory	0	0	3	1.5
7	Professional Core Courses (Lab)	20CE4L05	Fluid Mechanics & Hydraulic machinery Laboratory	0	0	3	1.5
8	Professional Core Courses (Lab)	20CE4L06	Concrete Technology Laboratory	0	0	3	1.5
	Skill Oriented Course*	20CE4S02	Road Safety Audit	**1**	**0**	**2**	**2**
Total credits							**21.5**
Internship 2 Months (Mandatory) during summer vacation							
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				**4**	0	**0**	**4**

III YEAR I SEMESTER							
S.No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	Professional Core Courses	20CE5T09	Design and Drawing of Reinforced Concrete Structures	3	0	0	3
2	Professional Core Courses	20CE5T10	Geotechnical Engineering	3	0	0	3
3	Professional Core Courses	20CE5T11	Highway Engineering	3	0	0	3
4	Open Elective Course/Job Oriented Elective	**Open Elective Course-I**		3	0	0	3
		20EE5T13	Renewable Energy Engineering				
		20ME5T21	Operations Research				
		20EC5T15	Principles of Communication Engineering				
		20AM5T04	Deep Learning				
		20HM5T03	Entrepreneurship				
5	Professional Elective Courses	**Professional Elective courses-I**		3	0	0	3
		20CE5T12	Repair & Maintenance of Structures				
		20CE5T13	Rock Mechanics				
		20CE5T14	Remote Sensing & GIS Applications				
		20CE5T15	Solid Hazardous and Waste Management				
		20CE5T16	Construction Technology and Management				
6	Professional Core Courses Lab	20CE5L07	Geotechnical Engineering Laboratory	0	0	3	1.5
7	Professional Core Courses Lab	20CE5L08	Transportation Engineering Laboratory	0	0	3	1.5
8	Skill Advanced Course/ Soft Skill Course*	20CE5S03	Analysis of Structure by Computer Aided Design (ETABS)	1	0	2	2
9	Mandatory Course (AICTE suggested)	20HM5T06	Essence of Indian Traditional Knowledge	2	0	0	0
10	#PROJ	20CE5I01	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)	0	0	0	1.5
11	PROJECT	20CE5P01	Community Service Project	0	0	0	4
Total Credits							**25.5**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				**4**	**0**	**0**	**4**

III YEAR II SEMESTER							
S.No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	Professional Core Courses	20CE6T17	Design & Drawing of Steel Structures	3	1	0	3
2	Professional Core Courses	20CE6T18	Water Resource Engineering	3	0	0	3
3	Professional Core Courses	20CE6T19	Environmental Engineering	3	0	0	3
4	Open Elective Course / Job Oriented Elective	**Open Elective Course-II**		3	0	0	3
		20EE6T19	Fundamentals of Electric Vehicles				
		20ME6T25	Introduction to Automobile Engineering				
		20EC6T26	Sensors and Transducers				
		20CS6T15	Computer Forensics				
5	Professional Elective Courses	**Professional Elective courses- II**		3	0	0	3
		20CE6T20	Industrial Structures				
		20CE6T21	Foundation Engineering				
		20CE6T22	Urban Hydrology Storm Drainage and Management				
		20CE6T23	Industrial Waste Management				
		20CE6T24	Railways, Airports & Seaports				
6	Professional Core Courses Lab	20CE6L09	Environmental Engineering Laboratory	0	0	3	1.5
7	Professional Core Courses Lab	20CE6L10	Estimation, Specification & Contracts lab	0	0	3	1.5
8	Professional Core Courses Lab	20CE6L11	STAAD & CAD Laboratory	0	0	3	1.5
9	Skill Advanced Course / Soft Skill Course*	20HE6S01	Soft Skills and Inter Personal Communication	1	0	2	2
10	Mandatory Course (AICTE)	20HM6T08	IPR and PATENTS	2	0	0	0
Total credits							**21.5**
	Honors/Minor courses(The hours distribution can be 3-0-2 or 3-1-0 also)			**4**	**0**	**0**	**4**
Industrial/Research Internship (Mandatory) 2 Months during summer vacation							

IV YEAR I SEMESTER							
S.No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	Professional Elective Courses	**Professional Elective - III**		3	0	0	3
		20CE7T25	Earthquake Resistance Design				
		20CE7T26	Ground Improvement Techniques				
		20CE7T27	River Management				
		20CE7T28	Bioremediation				
		20CE7T29	Traffic Engineering				
2	Professional Elective Courses	**Professional Elective - IV**		3	0	0	3
		20CE7T30	Bridge Engineering				
		20CE7T31	Soil Dynamics and Machine Foundations				
		20CE7T32	Irrigation Engineering				
		20CE7T33	Air Pollution & Control				
		20CE7T34	Pavement Analysis and Design				
3	**Professional Elective Courses**	**Professional Elective - V**		3	0	0	3
		20CE7T35	Pre-Stressed Concrete				
		20CE7T36	Earth & Rock fill Dams				
		20CE7T37	Water Resources System Planning				
		20CE7T38	Environmental Impact Assessment & Management				
		20CE7T39	Swayam /NPTEL/MOOCS courses (12 weeks duration)				
4	Open Elective Courses/ Job Oriented Elective	**Open Elective - III**		3	0	0	3
		20EE7T29	Battery Management Systems and Charging Stations				
		20ME7T28	Additive Manufacturing				
		20EC7T40	Industrial Electronics				
		20DS7T02	Big Data Analytics				
		20HM7T09	Organizational Behavior				
5	Open Elective Courses/ Job Oriented Elective	**Open Elective - IV**		3	0	0	3
		20EE7T30	Smart Grid Technologies				
		20ME7T38	Sustainable EnergyTechnologies				
		20EC7T41	Biomedical Instrumentation				
		20IT7T10	Cryptography and Network Security				
		20HM7T04	Marketing Management				

6	*Humanities And Social Science Elective	20HM7T11	Universal Human Values-II Understanding Harmony	**3**	**0**	**0**	**3**
7	Skill Advanced Course/ Soft Skill Course*	20CE7S05	Town Planning	1	0	2	2
Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester)				0	0	0	3
Total credits							**23**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				**4**	**0**	**0**	**4**

IV YEAR II SEMESTER							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
1	Major Project	20CE8P02	Project work	0	0	0	8
INTERNSHIP (6MONTHS)							
Total credits							8

OPEN ELECTIVE:

(WHICH ARE OFFERED TO OTHER DEPARTMENT)

S.No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	C
1	OPEN ELECTIVE-I	20CE5T01	Surveying	3	1	0	3
2	OPEN ELECTIVE-II	20CE6T40	Disaster Management	3	0	0	3
3	OPEN ELECTIVE-III	20CE7T11	Highway engineering	3	0	0	3
4	OPEN ELECTIVE-IV	20CE7T18	Water resource engineering	3	0	0	3

< Professional Communicative English >

< Common to CE, EEE, MECH, ECE, CSE, CSE (DS), CSE (AI&ML), & IT >

The following textbooks are recommended for study in I B.Tech I Semester (Common for all branches) of Pragati Engineering College, Surampalem from the academic year 2020-21 (R-20 Regulations)

DETAILED TEXTBOOK:

- **PROFESSIONAL COMMUNICATIVE ENGLISH** *Published by Maruthi Publishers.*

NON-DETAILED TEXTBOOK:

- ***PANORAMA: A COURSE ON READING****, Published by Oxford University Press India*

The course content, along with the study material, is divided into six units.

UNIT 1:

1. 'The Greatest Resource- Education' from Professional Communicative English.

Objective: Schumacher describes the education system by saying that it was mere training, something more than knowledge of facts.
Outcome: Underscores that the ultimate aim of Education is to enhance wisdom.
2. 'War' from 'Panorama: A Course on Reading'
Objective: To develop extensive reading skill and comprehension for pleasure and profit.
Outcome: Acquisition of LSRW skills

UNIT 2:

1. ' A Dilemma' from Professional Communicative English.
Objective: The lesson centres on the pros and cons of the development of science and technology.
Outcome: Enables the students to promote peaceful co-existence and universal harmony among people in society.
2.'The Verger' from 'Panorama: A Course on Reading'
Objective: To develop extensive reading skill and comprehension for pleasure and profit.
Outcome: Acquisition of LSRW skills

UNIT 3:

1. 'Cultural Shock': Adjustments to new Cultural Environments from Professional Communicative English.
Objective: Depicts of the symptoms of Cultural Shock and the aftermath consequences
Outcome: Enables the students to manage different cultural shocks due to globalization.
2. ' The Scarecrow' from Panorama: A Course on Reading
Objective: To develop extensive reading skill and comprehension for pleasure and profit.
Outcome: Acquisition of LSRW skills

UNIT 4:

1. 'The Secret of Work' from *Professional Communicative English.*

Objective: Portrays the ways of living life in its real sense.
Outcome: Arouses the thought to lead life in a right path by recognizing the importance of work.

2. 'A Village Lost to the Nation' from Panorama: A Course on Reading

Objective: To develop extensive reading skill and comprehension for pleasure and profit.
Outcome: Acquisition of LSRW skills

UNIT 5:

1. ' The Chief Software Architect' from Professional Communicative English.
Objective: Supports the developments of technology for the betterment of humanlife.
Outcome: Pupil gets inspired by eminent personalities who toiled for the present-day advancement of software development.

2. 'Martin Luther King and Africa' from Panorama: A Course on Reading
Objective: To develop extensive reading skill and comprehension for pleasure and profit.
Outcome: Acquisition of LSRW skills

Annexure - 1

Differential Equations and Numerical Methods

(Common to CE, EEE, ME, ECE, CSE, CSE-DS, CSE-AI&ML & IT)

I B. Tech I Semester

Course Category	Basic Sciences	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Differentiation, Integration	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2	The skills derived from the course will help the student form a necessary base to develop analytic and design concepts.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	solve first order differential equations and its applications	K3
CO2	solve the linear differential equations with constant coefficients by appropriate method	K3
CO3	apply Newton, Gauss and Lagrange interpolation formulae to find interpolating polynomials for the given data.	K3
CO4	find the approximate roots of transcendental equations by using different numerical methods	K2
CO5	solve initial value problems by using different numerical schemes	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Differential equations of first order and first degree** Linear – Bernoulli – Exact – Reducible to exact. **Applications:** Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories.
UNIT II	**Linear differential equations of higher order** Non-homogeneous equations of higher order with constant coefficients with non-homogeneousform □^□□, □□□□□, □□□□□polynomials in □^□, □^□□□(□), □^□□(□) - Methodof Variation of parameters.
UNIT III	**Interpolation** Introduction– Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences –Central differences –properties – Differences of a polynomial-Newton's formulae for interpolation –Gauss formulae for interpolation- Interpolation with unequal intervals: Lagrange's interpolation formula.
UNIT IV	**Solution of Algebraic and Transcendental Equations** Introduction- Bisection method – Method of false position – Iteration method – Newton-Raphson method (One variable).
UNIT-V	**Solution of Ordinary Differential equations** Solution of ordinary differential equations by Taylor's series-Picard's method of successive approximations-Euler's method – Modified Euler's method - Runge-Kutta method (second and fourth order).

TEXT BOOKS	
1.	**B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	**Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India
REFERENCE BOOKS	
1.	**Micheael Greenberg**, Advanced Engineering Mathematics, 9th edition, Pearson edn
2.	**Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
3.	**Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.
4.	**Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.
5.	**T.K.V. Iyengar et. al.,** Engineering Mathematics Volume I & III S Chand Publications.
WEB RESOURCES	
1.	**UNIT I: Differential equations of first order and first degree** https://en.wikipedia.org/wiki/Differential_equation http://um.mendelu.cz/maw-html/index.php?lang=en&form=ode https://www.khanacademy.org/math/differential-equations/first-order-differential-equations
2.	**UNIT II: Linear differential equations of higher order** https://en.wikipedia.org/wiki/Differential_equation http://um.mendelu.cz/maw-html/index.php?lang=en&form=ode https://nptel.ac.in/courses/122107037/20

3.	**UNIT III: Interpolation** https://en.wikibooks.org/wiki/Introduction_to_Numerical_Methods/Interpolation
4.	**UNIT IV: Solution of Algebraic and Transcendental Equations** https://en.wikibooks.org/wiki/Numerical_Methods/Equation_Solving https://www.slideshare.net/100005232690054/algebraic-and-transcendental-equations
5.	**UNIT V: Solution of Ordinary Differential Equations** https://nptel.ac.in/courses/111107063/ https://www.facweb.iitkgp.ac.in/~rajas/cgen/page/nptlcrs

< ENGINEERING PHYSICS >

< Common to I-I CE & ME branches >

Course Category	BASIC SCIENCES	**Course Code**	
Course Type	Theory	**L-T-P-C**	3 - 0 -0-3
Prerequisites	Intermediate Physics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Study the Crystal Structures, Properties and their relationship exhibited by Solid State materials for their utility.
2	Impart knowledge on magnetic materials with characteristic utility in appliances.
3	Simple harmonic motion and its adaptability for improved acoustic quality of concert halls- Impart concepts of flaw detection techniques using ultrasonics.
4	Impart knowledge in basic concepts of LASERs along with its Engineering applications- Familiarize types of sensors for various engineering applications
5	Impart the knowledge of Nanomaterials, Properties, characterization Techniques and Applications

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Apply the basics of crystal structures and X ray diffraction technique for material studies.	Application(K3)
CO2	Analyze the materials based on their magnetic properties and use them in possible applications.	Analysis(K3)
CO3	Analyze the factors behind acoustic defects and different ultrasonic testing techniques of materials using NDT	Analysis(K3)
CO4	Understand the basics principles of laser mechanism and Sensors for applications in engineering.	Understanding(K2)
CO5	Apply the knowledge of Nanomaterials and their properties for applications in engineering	Application(K3)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	1	1	-	-	-	-	-	-	-	-	-
CO4	2	-	-	2	-	-	-	-	-	-	-	2	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

< ENGINEERING PHYSICS >

< Common to I-I CE & ME branches >

COURSE CONTENT	
UNIT I	**CRYSTALLOGRAPHY & X-RAY DIFFRACTION** (**10 hrs)** Introduction-Basis and lattice – Unit cell - Coordination number -Packing fraction -Bravais lattice-Crystal Systems – packing fractions of SC,BCC and FCC-Crystal directions and planes-Miller indices – Separation between successive (h k l) planes – Bragg's law - Bragg's X-ray spectrometer.
UNIT II	**MAGNETIC PROPERTIES** **(10hrs)** Introduction-Magnetic-dipole-moment-Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment -Classification of Magnetic materials(Analytical) – Wiess Domain theory -Hysteresis-B-H Curve- soft and hard magnetic materials - applications **DIELECTRICS** Introduction - Dielectic polarization– Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations- Electronic Ionic and Orientational polarizations (qualitative) – Lorentz Internal field – Claussius-Mossoti equation -Applications of dielectrics.
UNIT III	**ACOUSTICS** (**10 hrs)** Introduction –Conditions for a good Hall- Reverberation - Reverberation time - Sabine's formula (Jaggers' Method using Eyrings approximation)–absorption coefficient and its determination- factors affecting acoustics of buildings and their remedies. **ULTRASONICS** Introduction-Production of ultrasonic's by Magneto-striction and piezoelectric methods – Detection of ultrasonic's- Non-Destructive Testing- pulse echo system through transmission and reflection modes - Applications.
UNIT IV	**LASERS** (**10 hrs)** Introduction-Characteristics–Spontaneous and Stimulated emission of radiation – population inversion - Pumping Mechanisms - Ruby laser – Helium Neon laser –Semiconductor laser– Applications **SENSORS (Qualitative description only):** Introduction-Strain and Pressure sensors-Piezoelectric-Magnetostrictive sensors- Temperature sensor-smoke and fire detectors-Applications.
UNIT V	**PHYSICS OF NANOMATERIALS** **(8hrs)** Introduction to Basics of Nano materials, Properties - Preparation methods (Sol Gel Technique, Ball Milling) and characterization Methods Scanning tunneling Microscopy, Atomic Force Microscopy – CNTs Preparation (Arc Discharge method) and properties - Applications of NanoMaterials (CNTs).

TEXT BOOKS	
1	"A text book of Engineering Physics" by P G Kshirsagar & M N Avadhanulu, S Chand & Company Ltd
2	"Solid State Physics" by SO Pilai., - New age International Publishers
3	"Engineeing Physics by P.K.Palanisamy, Scitech publications (New Edition 2019)

< ENGINEERING PHYSICS >

< Common to I-I CE & ME branches >

REFERENCE BOOKS	
1	"Sensor and Transducers" by Ian R Sinclair, Elsevier (Newnes) 3rd Eds
2	Kettles Introduction to Solid state Physics-Charles Kittel,Wiley India Edition
3	"Engineering Physics" by M.R.Srinivasan, New Age international publishers
WEB RESOURCES	
1	https://nptel.ac.in/courses/113/104/113104014/
2	https://nptel.ac.in/courses/113106032/15%20-%20Magnetic%20Properties.pdf https://nptel.ac.in/courses/113/104/113104090/
3	https://www.svce.ac.in/departments/physics/downloads/Notes/Unit-IV/UNIT%20IV%20Acoustics.pdf https://nptel.ac.in/courses/124/105/124105004/
4	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cy13/ http://engineering.nyu.edu/gk12/amps-cbri/pdf/Intro%20to%20Sensors.pdf
5	https://nccr.iitm.ac.in/2011.pdf https://nptel.ac.in/courses/118/104/118104008/

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COURSE CONTEl'IT

UNIT I

Introduction to Enginee1ing mechanics: Basic Concepts of mechanics, System of Forces.
Resultant System of forces: Resultant of Coplanar Concurrent Force System - Moment of a Force, Couple,Theorem, Resultant of Coplanar Non-Concurrent Force System.
Equilibrium System of forces: Equations of Equilibrium of Coplanar Systems, Free Body Diagram's, Theorem,Eq1:ilibrium of Connected Bodies.

UNIT II
Friction:Introduction, types of friction, lawsof dry friction, coefficient of friction, cone of friction.
T111sses:Introduction, Assumptions and Equilibrium analysis of plane trusses by using method of joints.

UNIT III :introduction, Centroids of simple and composite sections. Centre of Gravity: Simple bodies and Composite bodies, Pappus Theorem.
moment of Inertia: Definition -Transfer Theorem, Perpendicular Theorem, Polar moment ofInertia, moment of Inertia of Simple and Composite Figures, mass moment of inertia of simple bodies.

UNIT IV
Kinematics: DAlembert's Principle,Rectilinear Motionand curvilinear motion, Motion with Uniform Velocity, motion with Uniform Acceleration.
Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation, Equations of Plane Motion• Fixed Axis Rotation.

UNIT V
Work -Energy Method: Equationsfor Translation, Motion of Connected Bodies Fixed AxisRotation and Plane Motion.lrrpulse momentum method.

TLTI BOOKS

1. Engineering Mechanics– S.Timoshenko DH Young 5th Edition Mc Graw Hill
2. Engineering Mechanics - S.S.Bhavikatii, KG Rajasekharappa Revised Edition New international.

REFERENCE BOOKS

1. Engineering Mechanics,N.H Dubey Mc Graw Hill, 2013
2. EngineeringMechanics:A.K.Tayal, 14th edition 2nd reprint, Umesh publications, 2012
3. Engineering Mechanics, : R K Bansal 3rd edition, Laxmi Publications,1996
4. Engineering Mechanics: Statics & Dynamics, A.Nelson,Tata McGraw-Hill Education,2009.
5. Engineering Mechanics, Fedinand L.Sainger, Harper-Collins.

6. WEB RESOURCES

1. http://nptel.ac.inlcourses/\Vebcourse- contents/lITKANPUR/engg.mechanics/ui/course home 3.h
2. http://nptel.ac.in/courses/l22104015/
3. https://nptel.ac.in/courses/122104015/
4. https://freevide)lectures.comlcourse/2264/engineering-mechanics
5. https://nptel.ac.in/courses/112103108/3
6. https://nptel.ac.in/courses/115104094/54

I Year I semester

Basic Electrical and Electronics Engineering

(Only CIVIL Engg.)

Course Category	Engineering Sciences	**Course Code**	
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	**NA**	**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
1	To learn the basic principles of electrical circuit analysis.
2	To understand constructional details and operating principle of DC machines & Transformers.
3	To understand constructional details and operating principle details of alternator and 3-Phase induction motor
4	To study operation of PN junction diode, half wave, full wave rectifiers, PNP and NPN transistors and various semiconductor devices.
5	To study the operation of OP-AMPs.

COURSE OUTCOMES			
Upon successful completion of the course, the student will be able to:		**Cognitive Level**	
CO1	Analyze various electrical circuits	Analyzing	K4
CO2	Understand constructional details and operating principle of DC machines, single phase transformer, tests and analyze their performance.	Analyzing	K4
CO3	Explain operation of Three phase AC machines.	Understanding	K2
CO4	Analyze operation of half wave, full wave bridge rectifiers and Explain single stage CE amplifier and concept of various semiconductor devices.	Analyzing	K4
CO5	Analyze operation of OP-AMPs.	Analyzing	K4

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-	-	-
CO3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	3	2	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT 1	**Electrical Circuits** Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits – star-delta and delta-star transformations
UNIT 2	**DC Machines** Constructional details and operating principle – EMF equation –DC motor – torque equation – applications - speed control methods of DC motor – Swinburne's Test.
UNIT 3	**Transformers** Constructional details and operating principle of single phase transformers – EMF equation – equivalent circuit – Losses – OC & SC tests – efficiency. **3 Phase Induction Motors** Principle of operation of 3-Phase squirrel cage induction motor – electromagnetic torque equation - power flow - brake test - efficiency calculation – applications.
UNIT 4	**Alternators** Constructional details and operating principle of alternators – types –Regulation of alternator by synchronous impedance method.
UNIT 5	**Semiconductor Devices** PN junction diodes – characteristics – half wave and full wave rectifiers - PNP and NPN junction transistor, transistor as an amplifier – transistor amplifier – frequency response of CE amplifier – concepts of feedback amplifier – SCR – MOSFET - IGBT. **Operational Amplifiers** Introduction to operation amplifiers (Ideal OP-AMP) – Characteristics – applications (inverting, non-inverting, integrator and differentiator).

TEXT BOOKS	
1	William Hayt and Jack E. Kemmerley, Engineering Circuit Analysis, Mc Graw Hill Company, 6th Edition.
2	Surinder Pal Bali, Electrical Technology, Vol-I, Vol-II, Pearson Publications, 1st Editiom.
3	Basic Electrical and Electronics Engineering by M.S. Sukhija and T.K. Naga Sarkar, Oxford University Press.
4	R.L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, PEI/PHI 2006, 9th Edition.
REFERENCE BOOKS	
1	John Bird, Electrical Circuit Theory and Technology, Routledge Taylor and Francis Group, 5 th Edition.
2	M.S.Naidu and S.Kamakshiah, Basic Electrical Engineering, TMH Publications, 1 st Edition
3	Rajendra Prasad, Fundamentals of Electrical Engineering, PHI Publications, 2nd edition.
4	R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand & Co. 2 nd Edition
5	David A. Bell, Electronic Devices and Circuits, Oxford University Press, 5 th Edition.
WEB RESOURCES (Suggested)	
1	www.nptel.ac.in/courses/108108076/
2	https://nptel.ac.in/courses/122106025/

< Professional Communicative English >

< Common to CE, EEE, MECH, ECE, CSE, CSE (DS), CSE (AI&ML), & IT >

Subject Code:

DEPARTMENT OF ENGLISH

L	T	P	C
0	0	3	1.5

Professional Communicative English Lab

PRESCRIBED LAB MANUAL FOR SEMESTER I:

'**STRENGTHEN YOUR STEPS**: A Multimodal Course in Communication Skills' Published by Maruthi Publications.

OBJECTIVES: To enable the students to learn demonstratively the communication skills of listening, speaking, reading and writing.

OUTCOME: A study of the communicative items in the laboratory will help the students become successful in the competitive world.

The course content, along with the study material, is divided into six units.

UNIT 1:

Introduction
Consonant Sounds
Vowel Sounds

UNIT 2:

Rhythm and Pronunciation
Weak/strong and contrasted forms
Practice of Rhythm

UNIT 3: Dialogues

UNIT 4: Group Discussions

UNIT 5:

Presentations & Public Speaking

UNIT-6: Interviews

<ENGINEERING PHYSICS LABORATORY>

<Common to I-I CE & ME)>

Course Category	BASIC SCIENCES	**Course Code**	
Course Type	Lab	**L-T-P-C**	0 -0-3-1.5
Prerequisites	Intermediate Physics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The student will have exposure to various experimental skills which is essential for an Engineering student.
2	To gain practical knowledge by applying the experimental methods to correlate with the Theoretical Physics.
3	Apply the Analytical techniques and graphical analysis to the experimental data

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Understand the basics of Mechanics, Elasticity, Diffraction using instruments like Fly wheel, Stewart Gee's, Grating	Understanding(K2)
CO2	Understand the basics of Waves and Oscillations in Physics using instruments like Volume Resonator, Sonometer.	Application(K3)
CO3	Determine the Magnetic and Dielectric constants of materials	Application(K3)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT: (Any 10 of the following listed 15experiments) 8 experiments in Regular mode and any two experiments in Virtual Mode(Virtual Lab)	
1.	Determination of Rigidity modulus of a material- Torsional Pendulum.
2.	Determination of Young's modulus by method of single cantilever oscillations.
3.	Determination of Acceleration due to Gravity and Radius of Gyration - Compound Pendulum.
4.	Verification of laws of transverse vibrations in a stretched strings – Sonometer.
5.	Determination of ultrasonic velocity in liquid (Acoustic grating)
6.	Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus
7.	Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
8.	Determination of dielectric constant by charging and discharging method
9.	Newton's rings – Determination of Radius of Curvature of Plano - Convex Lens.
10.	Determination of wavelength of Laser by diffraction grating
11.	Determination of particle size using Laser.
12.	Determination of Moment of Inertia of a Fly Wheel.
13.	Determination of Velocity of sound –Volume Resonator.
14.	Determination of Numerical Aperture and acceptance angle of an Optical Fiber
15.	Determination of wavelength of a light using Diffraction Grating-Normal incidence.

TEXT BOOKS	
1.	College customized manual
WEB RESOURCES	
1.	www.vlab.co.in (virtual lab link)

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

ELECTRICAL AND ELECTRONICS ENGINEERING

I Year I semester

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

(Only CIVIL Engg.)

Course Category	Engineering Sciences	**Course Code**	
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	**NA**	**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
1	To determine the voltage, current and power in star and delta connected loads
2	To predetermine the efficiency of DC shunt machine using Swinburne's test
3	To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests.
4	To obtain performance characteristics of DC shunt generator & 3-phase induction motor.
5	To find out regulation of an alternator with synchronous impedance method.
6	To control speed of dc shunt motor using Armature voltage and Field flux control methods.
7	To find out the characteristics of PN junction diode & transistor
8	To determine the ripple factor of half wave & full wave rectifiers.
9	To find out the band width of transistor CE amplifier.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Determine the voltage, current and Power in Star and Delta Connected loads.	K3
CO2	Compute the efficiency of DC shunt machine without actual loading of the machine	K3
CO3	Estimate the efficiency and regulation at different load conditions and power factors for single phase transformer with OC and SC tests.	K5
CO4	Analyze the performance characteristics to determine critical speed and resistance of DC shunt generator & efficiency of 3-Phase induction motor.	K4
CO5	Pre-determine the regulation of an alternator by synchronous impedance method.	K4
CO6	Control the speed of DC shunt motor using Armature voltage and Field flux control methods.	K3
CO7	Draw the characteristics of PN junction diode & transistor	K2
CO8	Determine the ripple factor of half wave & full wave rectifiers	K3
CO9	Analyze the frequency response of to find the bandwidth of CE amplifier	K4

PRAGATI ENGINEERING COLLEGE: SURAMPALEM
(Autonomous)
ELECTRICAL AND ELECTRONICS ENGINEERING

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO7	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO8	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO9	2	-	-	-	-	-	-	-	-	2	-	-	-	-

LIST OF EXPERIMENTS:	
Section A: Electrical Engineering(Any 6 of the following experiments are to be conducted)	
Experiment 1	Measurement of voltage, current and Power in Star and Delta Connected loads
Experiment 2	Magnetization characteristics of DC Shunt Generator
Experiment 3	Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shunt machine working as motor and generator).
Experiment 4	Speed control of D.C. Shunt motor by a) Armature Voltage control b) Field control method.
Experiment 5	OC and SC tests on single phase transformer (predetermination of efficiency and regulation at given power factors).
Experiment 6	Load Test on Single Phase Transformer
Experiment 7	Brake test on 3-phase Induction motor (determination of performance characteristics)
Experiment 8	Regulation of alternator by Synchronous impedance method.
Section B: Basic Electronics(Any 4 of the following experiments are to be conducted)	
Experiment 9	PN junction diode characteristics a) Forward bias b) Reverse bias
Experiment 10	Transistor CE characteristics (input and output)
Experiment 11	Half wave rectifier with and without filters.
Experiment 12	Full wave rectifier with and without filters.
Experiment 13	CE amplifiers.
Experiment 14	OP- amp applications (integrator and differentiator).

Linear Algebra and Partial Differential Equations
(Common to CE, ME, ECE, CSE, IT, CSE-DS, CSE-AI&ML)

I B. Tech II Semester

Course Category	Basic Sciences	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Basics of Matrices, Differentiation, Integration	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2	The skills derived from the course will help the student form a necessary base to develop analytic and design concepts.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	solve systems of linear equations, determine the rank, find the eigenvalues and eigenvectors, diagonalization of a matrix.	K3
CO2	identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics.	K2
CO3	find areas and volumes using double and triple integrals	K2
CO4	find partial derivatives of multivariable functions and apply them to find extreme values of a function.	K3
CO5	apply a range of techniques to find solutions of standard PDEs	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Solving system of linear equations, Eigen Values and Eigen vectors** Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss elimination method, Gauss Jacobi and Gauss Seidel for solving system of equations – Eigenvalues and Eigen vectors and their properties.
UNIT II	**Cayley-Hamilton Theorem and Quadratic forms** Cayley-Hamilton theorem (without proof) – Finding inverse and powers of a matrix by Cayley-Hamilton theorem – Quadratic forms-Reduction to canonical form by congruent transformations- nature of the quadratic form - reduction of quadratic form to canonical form by orthogonal transformation.
UNIT III	**Multiple integrals** Multiple integrals: Double and triple integrals – Change of variables -Polar coordinates - Cylindrical coordinates– Change of order of integration. **Applications:** Finding Areas and Volumes.
UNIT IV	**Partial differentiation** Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Generalized Mean value theorem for single variable (without proof) – Taylor's and Maclaurin's series expansion of functions of two variables – Jacobian – Functional dependence. **Applications:** Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).
UNIT V	**Partial Differential Equations and Applications** Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations. **Applications:** One dimensional wave and heat equations.

TEXT BOOKS	
1.	**B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2.	**Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India
REFERENCE BOOKS	
1.	**Micheael Greenberg**, Advanced Engineering Mathematics, 9th edition, Pearson edn
2.	**Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press
3.	**Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.
4.	**Srimanta Pal, Subodh C. Bhunia**, Engineering Mathematics, Oxford University Press.
5.	**T.K.V. Iyengar et. al.,** Engineering Mathematics Volume I & III S Chand Publications.
6.	**T. Amarnath,** An Elementary Course in Partial Differential Equations, Narosa Publications

WEB RESOURCES	
1.	**UNIT I: Solving system of linear equations, Eigen Values and Eigen vectors** https://en.wikipedia.org/wiki/System_of_linear_equations https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
2.	**UNIT II: Cayley-Hamilton Theorem and Quadratic forms** https://www.math.hmc.edu/calculus/tutorials/eigenstuff/ https://en.wikipedia.org/wiki/Quadratic_form
3.	**UNIT III: Multiple Integrals** https://en.wikipedia.org/wiki/Multiple_integral http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx
4.	**UNIT V: Partial Differentiation** https://en.wikipedia.org/wiki/Partial_derivative https://www.whitman.edu/mathematics/calculus_online/section14.03.html
5.	**UNIT V: Partial Differential Equations and Applications** https://en.wikipedia.org/wiki/Partial_differential_equation

PRAGATI ENGINEERING COLLEGE (AUTONOMOUS)

SURAMPALEM

R – 20 Regulations

Board of studies Chemistry

Engineering Chemistry

(Common to CE, MECH)

Course Category	Basic Sciences	**Course Code**	
Course Type	Theory	**L-T-P-C**	3 – 0 – 3 – 4.5
Prerequisites	Intermediate Chemistry	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn about the hardness of water, boiler troubles, Drinking water standards and methods of removal of hardness of water.
2	To get knowledge on Electrochemical cells, Batteries, fuel cells and fuels and their applications.
3	To study about the factors affecting corrosion and their controlling methods.
4	To learn about Cement, its setting and hardening and about Polymers, Plastics and Elastomers.
5	To study about Nano materials, their preparation, and applications and to create awareness on surface chemistry.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Compare the quality of drinking water with BIS and WHO Standards	Understanding (K2)
CO2	Illustrate the principles and applications of Batteries, Fuel cells and fuels.	Applying (K3)
CO3	Identify different types of corrosion and their controlling methods.	Applying (K3)
CO4	Illustrate the principles of setting and hardening of cement and explain about polymers and their engineering applications.	Understanding (K2)
CO5	Analyze the importance of nano materials and surface chemistry.	Analyzing (K4)

Contribution of Course Outcomes towards achievement of Program : Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		**2**	**1**	**2**		**3**	**3**				**2**	**1**	**1**		**1**
CO2	**2**	**1**			**2**		**1**				**2**	**2**			
CO3	**1**		**2**		**2**		**1**				**1**			**1**	
CO4	**3**		**1**	**2**		**1**	**1**				**2**		**1**		
CO5	**2**		**3**			**2**	**2**				**1**	**1**			

COURSE CONTENT	ENGINEERING CHEMISTRY SYLLABUS
UNIT I	**WATER TECHNOLOGY** **8 hrs** Introduction –Hard and Soft water, Estimation of Hardness by EDTA Method - Boiler troubles - Scale and Sludge- Specifications for Drinking water, Bureau of Indian Standards (BIS) and World Health Organization (WHO) standards, Zeolite and Ion-Exchange processes- Desalination of Brackish water, Reverse Osmosis (RO) and Electro Dialysis. **Learning Outcomes:** The student will be able to List the differences between temporary and permanent hardness of water (L1) Explain the Principles of Reverse Osmosis and Electro dialysis. (L2) Compare quality of Drinking water with BIS and WHO standards. (L2) Illustrate Disadvantages associated with hard water. (L2)
UNIT II	**ENERGY SOURCES AND APPLICATIONS** **10hrs** **Electrodes:** Electrode potential, Determination of Single Electrode Potential –Nernst's equation, Reference electrodes: Hydrogen and Calomel electrodes **Batteries:** Primary cell- Dry or Leclanche cell, Secondary cell- Lithium batteries (Lithium-MnO_2); **Fuel cells:** H_2-O_2 fuel cell, Methanol fuel cell **Fuels-** Types of fuels, Calorific value, Numerical problems based on Calorific value; Analysis of Coal, Liquid fuels : Refining of Petroleum, Cracking: Catalytic cracking- Fixed bed and Moving bed methods, Knocking and Anti knocking agents, Octane and Cetane Values. **Biofuels** – Bio Diesel, Power Alcohol. **Learning Outcomes:** At the end of this unit, the students will be able to Apply Nernst equation for calculating electrode and cell potentials (L3) Compare different batteries and their applications (L2) Explain calorific values, octane number, refining of petroleum and cracking of oils (L2)
UNIT III	**CORROSION AND ITS CONTROLLING METHODS** **6+6 hrs** **III-A: Corrosion:** Definition – Theories of Corrosion-Dry corrosion: Metal oxide formation - Pilling Bed Worth ratio; Electro Chemical Corrosion: Mechanism, Factors affecting the Corrosion rate (pH, temperature, DO). **III-B: Corrosion Controlling Methods:** Sacrificial and Impressed Current Cathodic Protection. Metallic Coatings – Galvanizing and Tinning- Electro Plating and Electroless Plating. **Learning Outcomes:** At the end of this unit, the students will be able to Apply Pilling Bedworth rule for Corrosion and Corrosion Prevention (L3) Demonstrate the corrosion prevention methods and factors affecting corrosion (L2)
UNIT IV	**POLYMER CHEMISTRY AND CEMENT** **10 hrs** **Polymers**: Introduction- Functionality of Monomers, Chain (Addition) Polymerization, Step (Condensation) Polymerization, Co-Ordination Polymerization, Co Polymerization with examples and Mechanism. Conducting Polymers – Mechanism of Conduction in Poly acetylene, Poly aniline and their Applications, **Plastics**: Thermoplastics and Thermo Setting Resins; Preparation, Properties and Applications of Polystyrene and Bakelite. **Elastomers**: Preparation, Properties and applications of Buna-S and Thiokol. **Cement:** Portland Cement, Constituents, Manufacture of Portland Cement, Chemistry of Setting and Hardening of Cement. **Learning Outcomes:** At the end of this unit, the students will be able to Explain different types of polymers and their applications (L2) Demonstrate the mechanism of conduction in conducting polymers (L2) Identify the constituents of Portland cement and explanation of the manufacturing of cement(L2) Enumerate the reactions at different temperatures in the Manufacture of Cement (L2)
UNIT V	**NANOMATERIALS AND SURFACE CHEMISTRY** **8 hrs** **Nanomaterials:** Introduction, Preparation of Carbon Nano Tubes (CNTs) by Arc discharge

	and Chemical Vapor Deposition Methods. Fullerenes -Preparation, Properties and Applications. Chemical synthesis of Nanomaterials: Sol-gel method, Applications of Nanomaterials in Wastewater treatment, Medicine and ***in Lubricants*.** **Surface Chemistry:** Introduction to Surface Chemistry, Colloids, Nanometals and Nanometal Oxides, Functionalization of Surface of Nanomaterials, Applications of Colloids and Nanomaterials in Catalysis and Sensors. **Learning Outcomes:** At the end of this unit, the students will be able to Classify Nanomaterials. (L-2) Explain the Synthesis and applications of Nanomaterials. (L-2) Identify the application of Colloids and Nanomaterials in Medicine, Sensors and Catalysis (L2)
TEXT BOOKS	
1	P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2	Engineering Chemistry by Shikha Agarwal: Cambridge University Press,2019 edition .
REFERENCE BOOKS	
1	Sashi Chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2	S.S. Dara, A Textbook of Engineering Chemistry, S.Chand& Co, (2010)
3	N. Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014)
WEB RESOURCES	
1	**Water Technology**
	1. https://www.scribd.com/document/.../Engineering-Chemistry-Unit-I-Water-Treatment 2. www.lenntech.com/applications/process/boiler/boiler-water-treatment.htm
2	**Energy Sources and Applications**
	https://en.wikipedia.org/wiki/Electrochemical_cell
3	**Corrosion and its controlling methods**
	https://en.wikipedia.org/wiki/Corrosion
4	**Polymer Chemistry and Cement**
	https://en.wikipedia.org/wiki/Polymer_chemistry
5	**Nano Materials and surface Chemistry**
	https://en.wikipedia.org/wiki/Nanomaterials

I-II Semester

Programming for Problem solving using C
(Common to CE, ME, EEE, ECE, CSE, CSE (AI&ML),CSE(DS), IT)

Course Category	Engineering Science	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
2	To gain knowledge of the operators, selection, control statements and repetition in C
3	To learn about the design concepts of arrays, strings, enumerated structure and union types and their usage.
4	To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
5	To assimilate about File I/O and significance of functions

COURSE OUTCOMES		**BTL**
Upon successful completion of the course, the student will be able to:		
CO1	Apply the fundamentals of C Programming for Problem solving.	K3
CO2	Identify the appropriate Decision statement and Loops for a given Problem.	K2
CO3	Make use of Arrays and Strings to solve the problems in C.	K3
CO4	design and implement programs to analyze the different pointer applications	K3
CO5	Develop solutions for problems using Files and Functions.	K3

Note: K1- Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1	0	0	0	0	0	0	0	1	1	0
CO2	3	3	3	3	1	0	0	0	0	0	0	0	1	1	0
CO3	3	3	3	2	1	0	0	0	0	0	0	0	2	1	0
CO4	2	3	3	3	1	0	0	0	0	0	0	0	2	2	0
CO5	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0

COURSE CONTENT	
UNIT I	**Introduction to Computers**: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers **Introduction to the C Language:** Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers. **Structure of a C Program:** Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.
UNIT II	**Bitwise Operators**: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators. **Selection & Making Decisions**: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions. **Repetition:** Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples.
UNIT III	**Arrays:** Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages **Strings:** String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application.
UNIT IV	**Pointers:** Introduction, Pointers to pointers, Compatibility, L value and R value Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application. Processor Commands: Processor Commands.
UNIT V	**Functions:** Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion **Text Input / Output:** Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

TEXT BOOKS	
1.	Programming for Problem Solving, Beerhouse A. Forouzan, Richard F.Gilberg, CENGAGE.
2.	The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2e, Pearson.
REFERENCE BOOKS	
1.	Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill.
2.	Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson.
3.	Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/106104128/
2.	http://students.iitk.ac.in/programmingclub/course/#notes
3.	http://c-faq.com/~scs/cclass/cclass.html
4.	http://www.youtube.com/watch?v=b00HsZvg-V0&feature=relmfu
5.	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practical-programming-in-c-january-iap-2010/

COURSE CONTENT

UNIT I

Introduction to Engineering Drawing.

Polygons: Constructing regular polygons by general method.

Curves: Parabola, Ellipse and Hyperbola by general methods tangent & normal for the curves. Cycloid and Involutes.

Scales: Vernier and Diagonal scales.

UNIT II

Orthographic Projections: Introduction, importance of reference lines, projections of points in various quadrants. Projections of straight lines inclined to both the planes, determination of true lengths and angle of inclination.

UNIT III

Projections of planes: Regular planes perpendicular/parallel to one plane. Regular planes inclined to one plane and parallel to other, inclined to both the planes.

UNIT IV

Projections of Solids: Simple positions of Prisms, Pyramids, Cones and Cylinders. Solids inclined to both the planes.

UNIT V

Isometric Projections: Introduction, Conversion of isometric views to orthographic views, Conversion of orthographic views to isometric views. Introduction to AutoCAD (Demo only)

TEXT BOOKS

1. Engineering Drawing by N.D. Bhatt, Chariot Publications, 56th Edition.
2. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age International (P) Limited (2008).

REFERENCE BOOKS

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers, 3rd Edition.
2. Engineering Graphics for Degree by K.C. John, PHI Publishers.
3. Engineering Graphics by PI Varghese, Mc Graw Hill Publishers, 2013.
4. Engineering Drawing by Basant Agarwal, Tata McGraw Hill Publishers, 2014.
5. B.V.R. Gupta & M. Raja Roy, Engineering Drawing, I.K. International Publishing House Pvt. Ltd., 2009

WEB RESOURCES

1. http://nptel.ac.in/courses/112103019/
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
3. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_health_science_stu dents/engineeringdrawing.pdf

DEPARTMENT OF CIVIL ENGINEERING
I Year II Semester
STRENGTH OF MATERIALS

Course Category	ESC	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

	COURSE OBJECTIVES
1	To impart preliminary concepts of Strength of Material and Principles of Elasticity and Plasticity Stress strain behavior of materials and their governing laws and to know the module of Elasticity and their relations.
2	To impart concepts of Bending Moment and Shear force for beams with different Boundary and loading conditions and to draw the diagrams of variation across the length.
3	To impart concepts of stresses developed in the cross section and bending Equations calculation of section modulus of sections with different cross sections.
4	The concepts above will be utilized in measuring deflections in beams under Various loading and support conditions.
5	To classify cylinders based on their thickness and to derive equations for Measurement of stresses across the cross section when subjected to external pressure.

	COURSE OUTCOMES
	At the end of successful completion of this course, the student will be able to:
CO1	Understand the concepts and principles, understand the theory of elasticity including strain/ displacement and Hooke's law relationships; and perform calculations, related to the strength of structured and mechanical components.
CO2	Perform stress analysis and design of beams subjected to bending and Shearing loads using several methods.
CO3	Understand the concepts of stresses developed in the cross section by using the bending equations and acquainted with the concept of shear stress Distribution across the cross sections of the beams.
CO4	Analyze the Stresses in thin and thick cylinders and Distribution of radial and Circumferential stresses for different boundary conditions.
CO5	Measure the deflections in beams under various loading and support condition

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	--	--	1	--	--	--	1	--	2	--	2	--
CO2	3	3	2	2	--	1	--	--	--	2	--	2	--	2	--
CO3	3	3	1	--	--	1	--	--	--	1	--	2	--	2	--
CO4	3	3	1	--	--	1	--	--	--	1	--	2	--	2	--
CO5	3	3	2	2	--	1	--	--	--	2	--	2	--	2	--

Syllabus:

UNIT – I

SIMPLE STRESSES AND STRAINS: Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – strain energy- gradual & sudden loads, Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses.

UNIT – II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load., uniformly varying loads and combination of these loads– Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III

FLEXURAL STRESSES: Theory of simple bending – Assumptions –Derivation of bending equation: M/I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections, built up beams, shear centre for Channel Sections and I-Sections.

UNIT –IV

THIN CYLINDERS: Thin seamless cylindrical shells –Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders – Thin spherical shells.

THICK CYLINDERS: Introduction Lame's theory for thick cylinders –Derivation of Lame's formulae – distribution of hoop and radial stresses across thickness – design of thick cylinders – compound cylinders – Necessary difference of radii for shrinkage – Thick spherical shells. Introduction to unsymmetrical bending.

UNIT – V

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L. Uniformly varying load.-Mohr's theorems – Moment area method – Conjugate beam method – application to simple cases including overhanging beams.

Text Books:

1. Strength of Materials by R. Subramanian
2. Strength of materials by R.K. Rajput, S. Chand & Co, New Delhi.
3. Strength of Materials by B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain

Reference Books:

1. Strength of Materials by S.S. Rattan, Tata McGraw Hill Education Pvt., Ltd.
2. Strength of Materials by S.Ramamrutham Dhanpat Rai Publishing Co., (P) Ltd. New Delhi
3. Theory of Structures by S.P.Timoshenko & DH. Young.
4. Strength of Materials by S. S. Bhavakatti
5. Strength of materials by R.K.Bansal vol 1 & 2

Programming for Problem solving using C Lab
(Common to CE, ME, EEE, ECE, CSE, CSE (AI&ML),CSE(DS), IT)

Course Category	Engineering Science	**Course Code**	
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Apply the principles of C language in problem solving.
2	To design flowcharts, algorithms and knowing how to debug programs.
3	To design & develop of C programs using arrays, strings pointers & functions.
4	To review the file operations, preprocessor commands.

COURSE OUTCOMES		**BTL**
Upon successful completion of the course, the student will be able to:		
CO1	Knowledge on various concepts of a C language.	K3
CO2	Draw flowcharts and write algorithms.	K3
CO3	Design and development of C problem solving skills.	K3
CO4	Design and develop modular programming skills.	K3

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0
CO2	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0
CO3	3	3	3	3	1	0	0	0	0	0	0	0	2	2	0

COURSE CONTENT	
1.	**Exercise 1:** 1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters. 2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches. 3. Write a C program to display multiple variables.
2.	**Exercise 2:** 1. Write a C program to calculate the distance between the two points. 2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".
3.	**Exercise 3:** 1. Write a C program to convert a string to a long integer. 2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape. 3. Write a C program to calculate the factorial of a given number.
4.	**Exercise 4:** 1. Write a program in C to display the n terms of even natural number and their sum. 2. Write a program in C to display the n terms of harmonic series and their sum. 1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms. 3. Write a C program to check whether a given number is an Armstrong number or not.
5.	**Exercise 5:** 1. Write a program in C to print all unique elements in an array. 2. Write a program in C to separate odd and even integers in separate arrays. 3. Write a program in C to sort elements of array in ascending order.
6.	**Exercise 6:** 1. Write a program in C for multiplication of two square Matrices. 2. Write a program in C to find transpose of a given matrix.
7.	**Exercise 7:** 1. Write a program in C to search an element in a row wise and column wise sorted matrix. 2. Write a program in C to print individual characters of string in reverse order.
8.	**Exercise 8:** 1. Write a program in C to compare two strings without using string library functions. 2. Write a program in C to copy one string to another string.
9.	**Exercise 9:** 1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation 2. Write a program in C to demonstrate how to handle the pointers in the program.

10.	**Exercise 10:** 1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator. 2.Write a program in C to add two numbers using pointers
11.	**Exercise 11:** 1. Write a program in C to add numbers using call by reference. 2. Write a program in C to find the largest element using Dynamic Memory Allocation.
12.	**Exercise 12:** 1.Write a program in C to swap elements using call by reference. 2.Write a program in C to count the number of vowels and consonants in a string using a pointer.
13.	**Exercise 13:** 1.Write a program in C to show how a function returning pointer. 2. Write a C program to find sum of n elements entered by user. To performthis program, allocate memory dynamically using malloc( ) function.
14.	**Exercise 14:** 1.Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs 2. Write a program in C to convert decimal number to binary number using the function.
15.	**Exercise 15:** 1. Write a program in C to check whether a number is a prime number or not using the function. 2. Write a program in C to get the largest element of an array using the function.
16.	**Exercise 16:** 1. Write a program in C to append multiple lines at the end of a text file. 2. Write a program in C to copy a file in another name. 3. Write a program in C to remove a file from the disk.

PRAGATI ENGINEERING COLLEGE (Autonomous), SURAMPALEM

R-20 Regulations

Board of Studies Chemistry

ENGINEERING CHEMISTRY LAB

Course Category	Basic sciences	**Credits:**	1.5
Course Type	Lab	**Lecture-Tutorial-Practice:**	0 -0 -3
Prerequisites	Basic Chemistry	**Continuous Evaluation:**	25
		Semester end Evaluation:	50
		Total Marks:	75

COURSE OUTCOMES		
Upon successful completion of this course, the student will be able to:		**Cognitive Level**
CO1	estimate the given amount of dissolved compounds in a solution by using volumetric analysis and preparation of polymers and nano particles	Applying (K3)
CO2	determine the concentration of different metal ions present in water by compelxometric titrations.	Understanding (K2)
CO3	evaluate the accurate value of P^H and conductivity of given solutions and to estimate the viscosity and surface tension of given solutions.	Evaluating (K5)

Contribution of Course Outcomes towards achievement of Program Outcomes (1–Low, 2-Medium,3–High)

	P01	**P02**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**P09**	**P010**	**P011**	**P012**	**PS01**	**PSO2**
CO1	**2**	**1**	**2**											
CO2	**2**	**1**		**1**										
CO3	**2**	**1**												

COURSE CONTENT

(Any 10 of the following listed 13 experiments)

LIST OF EXPERIMENTS:

Introduction to chemistry laboratory –Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis

1. Estimation of HCI using standard Na_2CO_3 solutions
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH
3. Estimation of $KMnO_4$ using standard Oxalic acid solution.
4. Estimation of Ferrous iron using standard $K_2Cr_2O_7$ solution
5. Determination of Temporary and permanent Hardness of water using standard EDTA solution.
6. Determination of pH of the given sample solution using pH meter
7. Determination of Fe (III) using Colorimetric method
8. *Estimation of HCl using standard NaOH by Conductometric titration.*
9. Estimation of Vitamin – C
10. Preparation of Phenol - Formaldehyde Resin
11. Determination of viscosity of a liquid
12. Determination of surface tension of a liquid
13. Preparation of Nano particles.(Cu/Zn)

TEXTBOOKS

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

REFERENCEBOOKS

Vogel's Textbook of Quantitative chemical analysis, J. Mendham et.al.

[1] College designed manual

WEB-RESOURCES

www.bsauniv.ac.in/UploadImages/Downloads/Estimation%20of%20Hardness
https://pubs.acs.org/doi/abs/10.1021/i560133a023

I Year II Semester

ENGINEERING WORKSHOP
(For ME and CE)

Course Category	Engineering Science	**Course Code**	
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Nil	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To familiarize with the basic material removal/shaping processes.
2	To study the various tools and equipment used in different hands on sessions.
3	To develop a skill in dignity of labor, precision, safety at work place.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Practice on manufacturing of components using workshop trades including fitting and carpentry.	K3
CO2	Design different types of models by using workshop trades including black smithy and tin smithy.	K4
CO3	Apply basic electrical engineering knowledge for house wiring practice.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	-	-	-	-	-	-	-	3	3
CO2	3	-	3	-	3	-	-	-	-	-	-	-	3	3
CO3	3	-	3	-	3	-	-	-	-	-	-	-	3	3

LIST OF EXPERIMENTS

A. Carpentry:
1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

B. Fitting:
1. V Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

C. Black Smithy:
1. Round rod to Square
2. S-Hook
3. U- Hook
4. Round Rod to Flat Ring

D. House Wiring:
1. Parallel Connection of three bulbs
2. Series Connection of three bulbs
3. Stair Case wiring
4. Florescent Lamp Fitting

E. Tin Smithy:

1. Square Box without lid
2. Open Scoop
3. Taper Tray
4. Funnel

Note: At least two exercises to be done from each trade.

Environmental Sciences

(Common to CE, ME, ECE, CSE, CSEDS&AI, IT)

Course Category	Basic Sciences	**Course Code**	**20BE1MC01**
Course Type	Theory	**L-T-P-C**	3 – 0 – 0 – 0
Prerequisites	Basic Knowledge in Environment and protection.	**Internal Assessment** **Semester End Examination** **Total Marks**	0 0 0

COURSE OBJECTIVE:	
1	To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Gain a higher level of personal involvement and interest in understanding and solving environmental problems.
CO2	Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities
CO3	Demonstrate knowledge relating to the biological systems involved in the major global environmental problems of the 21st century
CO4	Recognize the interconnectedness of human dependence on the earth's ecosystems
CO5	Influence their society in proper utilization of goods and services.
CO6	Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	1	0	0	1	2	0	0	0	1	0	0	0
CO2	0	1	0	0	0	0	1	0	0	0	0	0	0	0
CO3	0	0	0	0	2	0	1	0	0	0	0	0	0	0
CO4	0	0	0	0	1	1	3	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	3	1	0	0	0	0	0	0

Course contents:

UNIT – I

Multidisciplinary nature of Environmental Studies

Definition, Scope and Importance-*International Efforts & Indian Environmentalists*

Natural Resources

Forest resources : deforestation – Mining, dams and other effects on forest and tribal people.
Water resources :Use and over utilization of surface and groundwater.
Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems.
Energy resources: renewable and nonrenewable energy sources.
Role of an individual in conservation of natural resources.Equitable use of resources for sustainable lifestyles.

LEARNING OUTCOMES:

Students will be able to

Articulate the basic structure, functions, and processes of key social systems affecting the environment
Explain why renewable and non-renewable energy resources are important.
Explain how water resources should be used.

UNIT- II

Ecosystems, Biodiversity and its conservation

Definition of Ecosystem and its structure, Functions
Biodiversity Definition-Value of biodiversity, India as a mega-diversity nation, Threats to biodiversity, Conservation of biodiversity, *Endangered and endemic species of India*.

LEARNING OUTCOMES:

Students will be able to

Get a clear picture of structure and functions of ecosystems.
Demonstrate knowledge and understanding of theories in the field of Biodiversity and Systematic in the broad sense.
Explain endangered and endemic species of India.

UNIT III

Environmental Pollution and Solid Waste Management

Definition, Cause, Effects of Air pollution, Water pollution, Noise pollution, Radioactive pollution, Role of an individual in prevention of pollution.
Solid Waste Management: Sources, effects and control measures of urban and industrial waste,
e-waste management

LEARNING OUTCOMES

Students will be able to

Understand Cause, effects and control measures of air pollution.
Understand solid waste management.

UNIT IV

Social Issues and the Environment

Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act-Issues involved in enforcement of environmental legislation, Rain water harvesting, Global Environmental challenges-*case studies*

LEARNING OUTCOMES:

Students will be able to

Explain the enforcement of Environmental legislations

Acquire knowledge on various environmental challenges induced due to unplanned anthropogenic activities.

Explain the reasons for global warming

UNIT-V

Human population and the Environment

Population growth, Women and child welfare, Role of Information technology in environment and human health. *Impact Assessment and its significances, stages of EIA*

Field work:

A mini project related to Environmental issues / to visit a local polluted site (Submission of project by every student)

LEARNING OUTCOMES

Students will have

Explain various types of information technologies

Explain the theories of population explosion

Acquire knowledge on various environmental challenges induced due to unplanned anthropogenic activities

DEPARTMENT OF ENVIRONMENTAL SCIENCES

TEXT BOOKS	
1.	Environmental Studies for undergraduate courses by ErachBharucha,UGC.
2.	A Textbook of Environmental Studies by Dr.S.AzeemUnnisa,Acadamic publishing company.
3.	Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai
REFERENCE BOOKS	
1.	Text Book of Environmental Studies by Deeshita Dave & P. UdayaBhaskar, Cengage learning.
2.	Glimpses of Environment by K.V.S.G. Murali Krishna Published by Environmental Protection Society, Kakinada, A.P.
3.	Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi
4.	Environmental Studies by PiyushMalaviya, Pratibha Singh, Anoopsingh: Acme Learning, New Delhi.
5.	An Introduction to Environmental Pollution by Dr.B.k.Sharma AND Dr.(Miss)H.kaur,Goel publishing House ,a unit of Krishna Prakasham Media (p) LH,Meerut –India
WEB RESOURCES	
1.	**UNIT-1: MULTI DISPLINARY NATURE OF ENVIRONMENT and NATURAL RESOURCES** http://www.defra.gov.uk/environment/climatechange https://www.climatesolutions.org

	https://en.wikibooks.org/wiki/Ecology/Ecosystems
2.	**UNIT-2:ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION** http://conbio.net/vl/ and www.biodiversitya-z.org/content/biodiversity
3.	**UNIT-3: ENVIRONMENTAL POLLUTION** https://www.omicsonline.org/environment-pollution-climate-change.php and https://www.britannica.com/technology/solid-waste-management
4.	**UNIT-4: SOCIAL ISSUES ANDTHE ENVIRONMENT** http://www.publichealthnotes.com/solid-waste-management/
5.	**UNIT-5: HUMANPOPULATION AND THE NVIRONMENT**http://www.ecoindia.com/education/water-conservation.html https://thewaterproject.org/water_conservation\ https://legalcareerpath.com/what-is-environmental-law/

II Year I Semester
Transforms and Vector Calculus

Course Category	Basic Sciences	**Course Code**	20BM3T03
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Nil	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
2	The skills derived from the course will help the student form a necessary base to develop analytic and design concepts.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Examine the properties of Laplace Transformation	K3
CO2	Solve ordinary differential equations by using Laplace transformation technique	K2
CO3	Expand a periodic function as a Fourier series and find Fourier transform of a given function.	K3
CO4	Understand vector differential properties of scalar and vector point functions and their applications.	K2
CO5	Apply Green's, Stokes and Divergence theorem to evaluate line, surface and volume integrals.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	-	-	-	-	-	-	-	-	-			
CO2	3	3	2	-	-	-	-	-	-	-	-	-			
CO3	3	3	2	-	-	-	-	-	-	-	-	-			
CO4	3	3	2	-	-	-	-	-	-	-	-	-			
CO5	3	3	2	-	-	-	-	-	-	-	-	-			

COURSE CONTENT

UNIT I

Laplace transforms: Laplace transforms of standard functions – Properties - Periodicfunctions - Unit step function – Dirac's delta function.

UNIT II

Inverse Laplace transforms: Inverse Laplace transforms – Properties – Convolutiontheorem (without proof).

Applications: Solving ordinary differential equations (initial value problems) using Laplacetransforms.

UNIT III

Fourier Analysis: Introduction- Periodic functions – Dirichlet's conditions - Fourier series ofa function, even and odd functions –Change of interval – Half-range sine and cosine series.

Fourier integral theorem (without proof) – Fourier sine and cosine integrals – sine and cosinetransforms – Inverse transforms..

UNIT IV

Vector Differentiation: Gradient - Directional derivative - Divergence – Curl – Laplacian and second order operators – Vector identities.

UNIT-IV

DETERMINATION OF FORCES IN TRUSSES:

Vector Integration: Line integral – Work done – Potential function – Area, Surface and volume integrals - Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and related problems.

TEXT BOOKS

1. **B.S.Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

REFERENCE BOOKS

1. **Micheael Greenberg**, Advanced Engineering Mathematics, 9th edition, Pearson edn Introduction to text book of Strength of Material by U.C. Jindal, Galgotia publications.
2. **Dean G. Duffy**, Advanced engineering mathematics with MATLAB, CRC Press **Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.
3. **Peter O'neil**, Advanced Engineering Mathematics, Cengage Learning.

WEB RESOURCES

	UNIT I: Laplace transforms
1	https://en.wikipedia.org/wiki/Laplace_transform https://web.stanford.edu/~boyd/ee102/laplace.pdf
	UNIT II: Inverse Laplace transforms
2	https://www.intmath.com/laplace-transformation/7-inverse-laplace-transform.php
	Unit – III: Fourier Analysis
3	https://www.mathsisfun.com/calculus/fourier-series.html https://lpsa.swarthmore.edu/Fourier/Xforms/FXformIntro.html
	UNIT IV: Vector Differentiation
4	https://en.wikipedia.org/wiki/Vector_calculus
	UNIT V: Vector Integration
5	https://en.wikipedia.org/wiki/Divergence_theorem http://tutorial.math.lamar.edu/Classes/CalcIII/StokesTheorem.aspx

SOLID MECHANICS

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core Course	**Course Code**	20CE3T02
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Mechanics & Strength of Materials	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To give concepts of Principal stresses and strains developed in cross section of the beams analytically as well as graphically due to stresses acting on the cross section and stresses on any inclined plane. To impart concepts of failures in the material considering different theories.
2	To give concepts of torsion and governing torsion equation, and there by calculate the power transmitted by shafts and springs.
3	To classify columns, calculation of load carrying capacity and to assess stresses due to axial and lateral loads for different edge conditions.
4	To calculate combined effect of direct and bending stresses on different engineering structures.
5	Introduce the concept of unsymmetrical bending in beams, location of neutral axis and deflection of beams under unsymmetrical bending.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Relate to principal stresses, strains under various loading conditions.	K2
CO2	Understand the concept of torsion in circular shafts.	K2
CO3	Analyze columns and struts under different loading conditions with different end conditions.	K3
CO4	Analyze direct and bending stresses in dams, retaining walls and chimneys.	K4
CO5	Analyze the stresses in beams subjected to unsymmetrical bending and calculate the shear centre for symmetrical and unsymmetrical sections.	K4

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	1	--	1	--	--	--	1	--	2	--	2	--
CO2	3	3	2	--	--	1	--	--	--	1	--	2	--	2	--
CO3	3	3	2	--	--	1	--	--	--	1	--	2	--	2	--
CO4	3	3	2	1	--	1	--	--	--	1	--	2	--	2	2
CO5	3	3	2	1	--	1	--	--	--	1	--	2	--	2	2

COURSE CONTENT

UNIT I

PRINCIPAL STRESSES AND STRAINS:

Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses Accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.

THEORIES OF FAILURES:

Introduction – Various theories of failures like Maximum Principal Stress Theory – Maximum Principal Strain Theory – Maximum Shear Stress Theory – Maximum Strain Energy Theory – Maximum Shear

Strain Energy Theory.

UNIT II

TORSION OF CIRCULAR SHAFTS:

Theory of pure torsion – Derivation of Torsion equations: $T/J = q/r = N\phi/L$ – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories offailure.

SPRINGS: Introduction – Types of springs – deflection of close and open coiled helical springs under axial pull and axial couple – springs in series and parallel.

UNIT III

COLUMNS AND STRUTS:

Introduction – Types of columns – Short, medium and long columns – Axially loaded compression members – Crushing load – Euler's theorem for long columns - Assumptions - Derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column – Slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Long columns subjected to eccentric loading – Secant formula – Empirical formulae – Straight line formula – Prof. Perry's formula.

DIRECT AND BENDING STRESSES:

Stresses under the combined action of direct loading and B.M. Core of a section – determination of stresses in the case of chimneys, retaining walls and dams – conditions for stability – stresses due to direct loading and B.M. about both axes.

UNIT IV

UN-SYMMETRICAL BENDING:

Introduction – Centroidal principal axes of section – Graphical method for locating principal axes – Moments of inertia referred to any set of rectangular axes – Stresses in beams subjected to unsymmetrical bending – Principal axes – Resolution of bending moment into two rectangular axes through the centroid – Location of neutral axis – deflection of beams under unsymmetrical bending.

Shear Centre:

Introduction Shear centre for symmetrical and unsymmetrical sections (Channel, I, T and L Sections).

UNIT V

DETERMINATION OF FORCES IN TRUSSES:

Determination of Forces in members of plane pin-jointed (determinate) perfect trusses by (i) Method of Joints (ii) Method of Sections and (iii) Method of Tension coefficients. Analysis of various types of cantilevers and simply supported trusses by Method of Joints, Method of Sections and Tension Coefficients.

TEXT BOOKS

3. A Textbook of Strength of Materials, by R. K. Rajput, 7e, S. Chand & Co., New Delhi.
4. Strength of materials by R.K.Bansal.

REFERENCE BOOKS

4. Fundamentals of Solid Mechanics M.L. Gambhir, PHI Learning Pvt. Ltd., New Delhi.
5. Introduction to text book of Strength of Material by U.C. Jindal, Galgotia publications.
6. Strength of materials by S.S. Bhavakatti.

WEB RESOURCES

1. https://nptel.ac.in/courses/105105108/1

FLUID MECHANICS

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional core	**Course Code**	20CE3T03
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Hydraulics.
2	To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass in fluid flow
3	To imbibe basic laws and equations used for analysis of dynamic fluids
4	To determine the losses in a flow system, flow through pipes, flow past immersed bodies
5	To study the applications of the Bernoulli's equation and different types of mouth piece

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Know the definitions of fundamental concepts of fluid mechanics.	K1
CO2	Identify the nature of flow in pipe and hydrostatic forces acting on submerged static fluid.	K3
CO3	Calculate the pressure and velocities by using the Bernoulli's equation and momentum equation.	K3
CO4	Estimate the head losses in a closed conduit flow interconnected with Reynolds number	K3
CO5	Justify the rate of flow through channels by using flow measurement devices.	K5

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	2	2	-	-	-	1	-	-	-	-	-	-	1	-
CO4	2	1	1	-	-	1	-	-	-	-	-	-	1	-
CO5	2	1	-	-	-	1	-	-	-	-	-	-	1	-

COURSE CONTENT

UNIT I

INTRODUCTION: Dimensions and units, Physical properties of fluids, specific gravity, viscosity, surface tension, vapor pressure and their influences on fluid motion, pressure at a point, Pascal's law, Hydrostatic law- Relationship between pressures.

MEASUREMENT OF PRESSURE-Pressure gauges, Manometers: Differential and Micro Manometers.

UNIT II

HYDROSTATICS: Hydrostatic forces on submerged plane-Horizontal, Vertical, inclined and curved surfaces – Centre of pressure. Derivations and problems.

FLUID KINEMATICS: Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification of flows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity for one, twos, three dimensional flows – stream and velocity potential functions, Flow net; Vortex flow – free vortex and forced vertex flow

UNIT III

FLUID DYNAMICS: Surface and body forces: Euler's and Bernoulli's equations for flow along a stream line for 3-D flow, Navier – Stokes equations (Explanatory).
Momentum equation and its application – forces on pipe bend.

UNIT IV

LAMINAR FLOW: Reynolds's experiment – Characteristics of Laminar & Turbulent flows. Flow between parallel plates, Flow through long tubes, flow through inclined tubes.
CLOSED CONDUIT FLOW: Laws of Fluid friction – Darcy's equation, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line. Pipe network problems, Moody's Chart.

UNIT V

MEASUREMENT OF FLOW: Pitot tube,Venturimeter and Orifice meter– classification of orifices, small orifice and large orifice, flow over rectangular, triangular and trapezoidal and stepped notches - Broad crested weirs. Classification of mouthpieces; Flow through external and internal cylindrical mouthpiece.

TEXT BOOKS

1. P.M. Modi and S.M. Seth, Hydraulics and Fluid Mechanics, Standard Book House.
2. R.K.Bansal,A text book of Fluid Mechanics and hydraulic Machines, Laxmi Publications(P) Ltd., New Delhi.

REFERENCE BOOKS

1. Introduction to Fluid machines by Edward J.Shaughnassy, Jr.Ira M.Katz & James P.Schaffer,Oxford University Press, New Delhi.
2. C. S. P. Ojha, R. Bemdtsson and P. N. Chandramoouli, Fluid Mechanics and Machinery, Oxford University Press, 2010.

WEB RESOURCES

1. http://nptel.ac.in/courses/105101082/

BUILDING MATERIALS AND CONCRETE TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional core	**Course Code**	20CE3T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	----------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To impart knowledge about basic building materials like lime bricks and stones.
2	To acquire knowledge about cement and its ingredients, aggregates and its properties.
3	To learn about concrete and its properties.
4	To familiarize concrete mix design.
5	To impart knowledge on special concretes.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Identify the good quality bricks and stones for construction.	K2
CO2	Understand material properties of cement and aggregates.	K2
CO3	Study the properties and manufacturing process of cement and its types.	K2
CO4	Design the concrete mixes for different exposure conditions.	K4
CO5	Study about various special types of concrete and their properties.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	3	2	-	-	-	3	3
CO2	3	3	2	2	1	2	-	2	2	1	-	-	3	3
CO3	3	3	2	2	-	-	1	3	2	1	2	2	3	2
CO4	2	3	2	2	-	2	-	3	2	-	3	2	3	3
CO5	3	3	2	2	2	-	-	3	2	-	-	-	3	2

COURSE CONTENT

UNIT I

STONES - BRICKS – LIME: Stone as building material - criteria for selection – Quarrying and Blasting - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive strength - Water Absorption - Efflorescence - Bricks for special use - Lime - Preparation of lime mortar

UNIT II

CEMENT – AGGREGATES: Cement - Ingredients - Manufacturing process - Types and grades - Properties of cement and Cement mortar - Tests on Cement - Fineness - Soundness, Consistency - Setting time - Coarse Aggregate -Crushing strength - Impact strength - Flakiness Index - Elongation Index - Abrasion resistance - Grading – Fine aggregate - grading – Bulking.

UNIT III

CONCRETE &CONCRETEBLOCKS: Concrete - Ingredients - Hydration - Batching plants – RMC - Properties of fresh concrete - Slump, Flow and Compaction factor - Properties of Hardened concrete - Compressive, Tensile and Shear strength -Modulus of rupture tests – Non-destructive testing.- Concrete hollow blocks - Lightweight concrete blocks.

UNIT IV

TIMBER, PAINTS & FINISHINGS:

WOOD: Structure, Properties, Seasoning of Timber and Defects in Timber.
PAINTS: Constituents of paint, Types of Paints, Varnish, White washing and distempering.
FINISHINGS: Damp proofing and water proofing materials and its uses, Plastering and Pointing.

UNIT V

MIX DESIGN: Factors in the choice of mix proportions – Durability of concrete – Quality Control of concrete Mix Specification - Concept and design of mix proportion - BIS method of mix design.
SPECIAL CONCRETES: Self compacting concrete–High strength and high-performance concrete – Fiber reinforcement concrete – Factors affecting properties of FRC –Light-weight concrete–Polymer concrete and its properties.

TEXT BOOKS

1. Concrete Technology, 5e, by M. L. Gambhir – Tata Mc. Graw Hill Publishers, New Delhi.
2. Concrete Technology, Theory and Practice, 8e, by M. S. Shetty – S. Chand& Co.
3. Building construction by Arora S.P and Bindra S.P, Dhanpat rai and sons.

REFERENCE BOOKS

1. Concrete Technology by A.R. Santha Kumar, Oxford University Press, New Delhi.
2. Properties of Concrete by A. M. Neville – PEARSON – 4th edition.
3. Varghese. P.C, Building Construction, Second Edition PHI Learning ltd., 2016.

WEB RESOURCES

1. http://freevideolectures.com/Course/3357/Concrete-Technology
2. https://nptel.ac.in/courses/105102012/

SURVEYING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE3T05
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	----------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Introduce the students to basic principles of surveying.
2	Demonstrate the basic surveying skills.
3	Perform various methods of linear and angles measurements.
4	Enable the students to use surveying equipment's.
5	Integrate the knowledge and produce topographical map.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate the fundamentals in chain and plane table surveying.	K2
CO2	Identify the angles on filed by compass survey.	K3
CO3	Apply knowledge of leveling in surveying.	K3
CO4	Measure the horizontal and vertical angles by using Theodolite and Total Station instruments.	K3
CO5	Estimate the volume and area of irregular boundaries of filed.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	--	--	1	--	--	--	--	3	--	--	2	3	--	2
CO2	3	3	1	2	--	--	--	--	2	--	--	2	3	--	2
CO3	3	--	--	2	--	--	--	--	3	--	--		2	--	3
CO4	3	3	1	3	3	--	--	--	3	--	--	2	3	--	3
CO5	3	3	3	3	--	--	--	--	--	--	--	2	3	2	3

COURSE CONTENT

UNIT I

INTRODUCTION: Definition-Uses of surveying, Objectives, Principles and Classifications of Surveying – Errors in survey measurements.

DISTANCEMEASUREMENTCONVENTIONS AND METHODS: Use of chain and tape, Errors and corrections to linear measurements, overview of plane table surveying.

UNIT II

COMPASS SURVEY: Definition- Principles of Compass survey - Meridians, Azimuths and Bearings, declination. Computation of angle - Purpose and types of Traversing - traverse adjustments – Local attraction.

UNIT III

LEVELING: Concept and Terminology, Levelling Instruments and their Temporary and permanent adjustments- method of levelling.

CONTOURING:

Characteristics and uses of contours- methods of conducting contour surveys and their plotting.

UNIT IV

THEODOLITE: Theodolite, description, principles - uses – temporary and permanent adjustments, measurement of horizontal and vertical angles. Principles of Electronic Theodolite – Omitted Measurements. Introduction to geodetic surveying - Total Station and Global Positioning System.

CURVES: Types of curves, design and setting out.

TACHEOMETRIC SURVEYING: Stadia and tangential methods of Tachometry.

MODERN SURVEYING METHODS: Principle and types of E.D.M. Instruments, Total station-advantages and Applications. Introduction to Global Positioning System.

UNIT V

COMPUTATION OF AREAS AND VOLUMES: Computation of areas along irregular boundaries and regular boundaries. Embankments and cutting for a level section and two-level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits.

TEXT BOOKS

1. Surveying (Vol No.1, 2 &3) by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) ltd, New Delhi.
2. Text book of Surveying by C. Venkataramaiah, University press, India (P) limited.

REFERENCE BOOKS

1. Text book of Surveying by S.K. Duggal (Vol No. 1&2), Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Text book of Surveying by Arora (Vol No. 1&2), Standard Book House, Delhi.

WEB RESOURCES

1. https://lecturenotes.in/notes/2827-note-for-surveying-1-s-1-by-swadhina-priyadarsini
2. https://nptel.ac.in/courses/105107122/1
3. https://nptel.ac.in/courses/105107158/

STRENGTH OF MATERIALS LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE3L01
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	Exposure to Engineering Mechanics	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: The student able to	
1	To determine the deflections, young's modulus in beams
2	To determine the torsion in circular shafts
3	To determine the impact value for given specimen
4	To determine the spring constant in open and closed coiled helical springs
5	To determine compression in the given specimen

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Develop the relationship between the stress and strain	K3
CO2	Find the deflections and flexural behavior of different beams.	K1
CO3	Relate to the concept of the torsion	K2
CO4	Compute the impact value of the specimen.	K3
CO5	Find the compression strength of the given specimen	K1

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	1	-	1	-	-	2	1	-	2	-	2
CO2	3	2	-	1	-	1	-	-	2	1	-	2	-	2
CO3	3	2	-	1	-	1	-	-	2	1	-	2	-	2
CO4	3	2	-	1	-	1	-	-	2	1	-	2	-	2
CO5	3	2	-	1	-	1	-	-	2	1	-	2	-	2

COURSE CONTENT

LIST OF EXPERIMENTS

1. Tension test on Mild Steel bar.
2. Bending test on (Steel / Wood) Cantilever beam.
3. Bending test on simple support beam
4. Torsion test
5. Hardness test
6. Spring test
7. Compression test on wood or concrete
8. Impact test
9. Shear test
10. Verification of Maxwell's Reciprocal theorem on beams.
11. Use of Electrical resistance strain gauges
12. Continuous beam – deflection test.

LIST OF MAJOR EQUIPMENT

1. UTM for conducting tension test on rods
2. Steel beam for flexure test
3. Wooden beam for flexure test
4. Torsion testing machine

5. Brinnell's / Rock well's hardness testing machine
6. Setup for spring tests
7. Compression testing machine
8. Izod & Charpy Impact machine
9. Shear testing machine
10. Beam setup for Maxwell's theorem verification.
11. Continuous beam setup
12. Continuous beam – deflection test.

TEXT BOOKS

1. A Textbook of Strength of Materials, by R. K. Rajput, 7e (Mechanics of Solids) SI Units S. Chand & Co, New Delhi
2. Strength of Materials by B.S.Basavarajaiah and P. Mahadevappa, 3rd Edition,Universities Press.

REFERENCE BOOKS

1. Fundamentals of Solid Mechanics M.L. Gambhir, PHI Learning Pvt. Ltd., New Delhi.
2. Introduction to text book of Strength of Material by U.C. Jindal, Galgotia publications.

WEB RESOURCES

1. www.nptel.ac.in/courses
2. https://theconstructor.org

SURVEYING FIELD-WORK LABORATORY

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core Lab	**Course Code**	20CE3L02
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: The student able to	
1	Accomplish the chain surveying for linear measurements.
2	Decide the Horizontal angles by compass surveying.
3	Draw the maps of the areas by plane table surveying.
4	Discriminate the levels of undulated ground by auto level.
5	Implement the leveling to know the road profile.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Compute the road widening and area by chain surveying.	K3
CO2	Survey the given area by compass surveying.	K3
CO3	Prepare maps for given land by plane table surveying.	K3
CO4	Differentiate various levels for specified areas.	K2
CO5	Design the road profile by auto level.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	--	--	1	--	--	--	--	3	--	--	2	3	--	2
CO2	3	3	1	2	--	--	--	--	2	--	--	2	3	--	2
CO3	3	--	--	2	--	--	--	--	3	--	--	--	2	--	3
CO4	3	3	1	3	3	--	--	--	3	--	--	2	3	--	3
CO5	3	3	3	3	--	--	--	--	--	--	--	2	3	2	3

COURSE CONTENT

1. Survey by chain survey of road profile with offsets in case of road widening.
2. Survey in an area by chain survey (Closed circuit).
3. Finding the area of the given boundary using compass (Closed Traverse).
4. Determination of distance between two inaccessible points by using compass.
5. Plane table survey: finding the area of a given boundary by the method of Radiation.
6. Plane table survey: finding the area of a given boundary by the method of intersection.
7. Fly levelling: Height of the instrument method (differential levelling).
8. Fly levelling: rise and fall method.
9. Fly levelling: closed circuit/ open circuit.
10. Fly levelling: Longitudinal Section and Cross sections of a given road profile.
11. Two Point Problem by the plane table survey.
12. Total Station: Determination of area using Total Station

13. Total Station: Determination of Remote height
14. Total Station: Determination of distance between two inaccessible points.

Note: Any 10 experiments are to be conducted among 14

TEXT BOOKS

1. Surveying (Vol No.1, 2 &3) by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications(P) ltd, NewDelhi.
2. Text book od Surveying by C. Venkataramaiah, University Press, India (P) Limited.

REFERENCE BOOKS

1. Text book of Surveying by S.K. Duggal (Vol No. 1&2), Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Text book of Surveying by Arora (Vol No. 1&2), Standard Book House, Delhi.
3. Advance Surveying by Satish Gopi, R. Sathi Kumar and N. Madhu, Pearson Publications.

WEB RESOURCES

1. https://lecturenotes.in/notes/2827-note-for-surveying-1-s-1-by-swadhina-priyadarsini
2. https://nptel.ac.in/courses/105107122/1
3. https://nptel.ac.in/courses/105107158/

BUILDING PLANNING AND DRAWING LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional core	**Course Code**	20CE3L03
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES:	
1	To understand about various sign conventions
2	To get knowledge about various bonds of brick masonry
3	To draw the plan, elevation and section of doors and windows
4	To draw the plan and section of stairs and foundation
5	To impart the planning aspects of residential and office building.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain about various types of sign conventions	K2
CO2	Apply techniques for effective project planning and management.	K3
CO3	Develop the building drawing as per standards in various phases of a project and detailing in construction.	K3
CO4	Plan the different types of residential buildings and various public buildings based on the minimum requirements.	K3
CO5	Creating and awareness of basic elements of drawing.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	1	1	-	3	3	1	1	-	-	2	-	-
CO2	-	-	-	-	-	-	2	-	1	-	-	2	-	-
CO3	-	-	-	-	-	-	2	1	1	1	1	1	-	-
CO4	-	1	-	-	-	-	2	1	1	1	1	1	-	-
CO5	-	1	-	1	2	1	2	1	2	2	2	1	-	-

COURSE CONTENT

1. Conventional signs.
2. English bond and Flemish bond.
3. Panelled door.
4. Glazed and panelled door.
5. Panelled window.
6. Glazed and panelled window.
7. King post truss.
8. Queen post truss.
9. Details of stairs.
10. Foundations.
11. Plan of a residential building.

12. Plan of an office building.

Note: Any 10 experiments are to be conducted among 12

TEXT BOOKS

1. Building Planning and Drawing by Dr. N. Kumaraswamy and A. Kameswara Rao, Ninth revised edition, 2019,Charotar Publications (P) Ltd, Gujarat.
2. Building Planning and Drawing by S. S. Bhavikatti& M. V. Chitawadagi, 2014, I. K. International Publishing House Pvt. Ltd.

SKILL ORIENTED COURSE

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Skill Oriented Course	**Course Code**	20CE3S01
Course Type	-------	**L-T-P-C**	1-0-2-2
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	

Topographic Survey with contour map (Total station)

CONSTITUTION OF INDIA

Course Category	Humanities including Management	**Course Code**	20CE4T06
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites	------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the evolution of Constitution of India	K2
CO2	Make use of one's Fundamental rights.	K3
CO3	Understand the functioning of the Union Government	K2
CO4	Understand the functioning of the State and local self Government.	K2
CO5	Understand the value of Indian Constitution in functioning of the country.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12	PSO1	PSO2
CO1	0	0	0	0	0	3	0	3	0	1	0	2	-	-
CO2	0	0	0	0	0	1	0	2	1	1	0	1	-	-
CO3	0	0	0	0	0	1	0	1	1	1	0	0	-	-
CO4	0	0	0	0	0	1	0	1	1	1	0	0	-	-
CO5	0	0	0	0	0	1	1	1	1	1	0	2	-	-

COURSE CONTENT

Unit – I

Introduction to Indian constitution: Meaning of the term constitution - History and development – Preamble of the Constitution – Constituent Assembly – The salient features of Indian Constitution.

Unit –II

Fundamental Rights: Individual and Collective Rights – Limitations of the fundamental Rights – Fundamental Rights Vs Duties.

Unit –III

Union Government: Union Legislature – Lok Sabha and Rajya Sabha (powers and functions) – President of India (powers and functions) – Prime minister of India (powers and functions) – Union Judiciary (supreme court powers and functions).

Unit – IV State and Local self Government:

State Government: State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council / Vidhan Parishad) – Powers and functions of state legislature – The Chief Minister of the state (powers and functions)

Local Self Government: Election commission of India (Powers and Functions)- The Union Public Service Commission (Powers and Functions)

Unit – V Working of the Indian Constitution

The values of the Indian Constitution and Ushering of Social Revolution in India – Nature and Role of Higher Judiciary in India – Amendments (Recent)

REFERENCE BOOKS

1. 'Indian Polity' by Laxmikanth
2. 'Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu

4. ‘Indian Administration’ by Avasti and Avasti

.

WEB RESOURCES

1. https://www.clearias.com/historical-background-of-indian-constitution/
2. https://www.civilserviceindia.com/subject/General-Studies/notes/functions-and-responsibilities-of-the-union-and-the-states.html

II Year II Semester
ENGINEERING GEOLOGY
DEPARTMENT OF CIVIL ENGINEERING

Course Category	Engineering science course	**Course Code**	20CE4T06
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To introduce the Engineering Geology as a subject in Civil Engineering.
2	To identify and know the varieties of minerals and rocks and their importance.
3	To know the variance of Geological structures below the earth.
4	To identify the seismic hazards posed at any given site.
5	To know the different Civil Engineering structures and their construction.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Introduce the subject and give a brief explanation to Civil Engineering importance of weathering.	K2
CO2	Observe and identify the properties of rocks and minerals and to impart a brief importance in the point of identification.	K2
CO3	Know a brief knowledge About Recognize of various structures of rock and to identify the differences between the geology and geophysics.	K1
CO4	Classify and measure the earthquake prone areas to practice the hazard Zone.	K4
CO5	Locate a suitable site for the construction of Civil engineering structures.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	2	2	2	3	-	-	2	2	-	3	-
CO2	2	1	1	3	2	2	1	-	-	2	3	-	-	-
CO3	1	1	1	2	3	3	2	-	-	2	3	-	-	-
CO4	3	1	1	3	2	3	2	-	-	2	3	-	-	-
CO5	1	1	1	2	3	3	2	-	-	2	3	-	-	-

COURSE CONTENT

UNIT I

INTRODUCTION: Branches of Geology, Importance of Geology in Civil Engineering with case studies.
WEATHERING: Weathering of rocks, Geological agents, weathering process of Rock, Factors affecting weathering types of weathering agents River process and their development. Landforms: produced by rivers. Erosion and Denudation

UNIT 2`

MINERALOGY AND PETROLOGY: Definitions of mineral and rock, Different methods of study on minerals and rocks, the study of physical properties of minerals and rocks for Macroscopic study for the Common rock forming minerals and other ore forming minerals. Classification structures, textures and forms of Igneous rocks Sedimentaryrocks, Metamorphic rocks and their study.

UNIT III

STRUCTURALGEOLOGY: a)Strike, Dip and Outcrop study of common geological structures

associating with the rocks such as Folds, Faults.

JOINTS AND UNCONFORMITIES - Parts types, Mechanism and their importance in Civil Engineering structural Geology Strength Comparisons of Igneous Sedimentary and metamorphic rock structures.

UNIT IV

GROUND WATER: Water table Cone of depression Geological controls of Ground Water Movement, Ground Water Exploration Techniques. Types of Aquifers- porosity and permeability and water bearing properties of rocks.

EARTHQUAKES AND LANDSLIDES: Terminology, Classification, causes and effects, Shield areas and Seismic belts Richter scale intensity Precautions of building constructions in seismic areas. Seismic Zones in India Classification of Landslides Causes and Effects measures to be taken prevent their occurrence at Landslides.

UNIT V

DAMS: Types and purpose of Dams, Geological considerations in the selection of a Dam, Remedial measures to be taken to select the dam site.

RESERVOIRS: Factors responsible in the selection of Reservoir site, Life of Reservoirs.

TUNNELS: Purpose of Tunneling, Effects, Lining of Tunnels. Influence of Geology for successful Tunneling.

TEXT BOOKS

1. Engineering Geology' by Subinoy Gangopadhay, Oxford University press.
2. Engineering Geology' by N. Chenna Kesavulu, Trinity Press (Laxmi Publications), 2nd Edition, 2014.

REFERENCE BOOKS

1. 'Engineering Geology for Civil Engineers' by P.C. Varghese, PHI learning pvt. Ltd.
2. Geology for Engineers and Environmental Society' by Alan E Kehew, person publications, 3rd edition.

WEB RESOURCES

1. **https://nptel.ac.in/courses/105/105/105105106/**

COMPLEX VARIABLES & STATISTICAL METHODS

Course Category	Basic Sciences	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To familiarize the complex variables
2	To familiarize the students with the foundations of probability and statistical methods.
3	To equip the students to solve application problems in their disciplines

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Find the differentiation and integration of complex functions used in engineering problems.	K2
CO2	Make use of the Cauchy residue theorem to evaluate certain integrals	K3
CO3	Apply discrete and continuous probability distributions	K3
CO4	Design the components of a classical hypothesis test	K4

COURSE CONTENT

UNIT I

Functions of a complex variable and Complex integration: Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.

Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs) and problems on above theorems

UNIT II

Series expansions and Residue Theorem: Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.

Types of Singularities: Isolated – Essential –Pole of order m– Residues – Residue theorem (without proof) – Evaluation of real integral of the types$\int\infty\ f(x)dx$ and $-\infty\ \int c+2\pi\ f(\ cos\theta,\ sin\theta)d\theta$.

UNIT III

Probability and Distributions: Review of probability and Bayer's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT IV

Sampling Theory: Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Representation of the normal theory distributions – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT V

Tests of Hypothesis: Introduction – Hypothesis – Null and Alternative Hypothesis – Type I andType II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

TEXT BOOKS

1. **B. S. Grewal,** Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. **Miller and Freund's,** Probability and Statistics for Engineers,Pearson,7th edition, 2008.

REFERENCE BOOKS

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9th edition, Mc-Graw Hill, 2013.
2. **S.C. Gupta and V.K. Kapoor**, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons Publications, 2012.
3. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.

WEB RESOURCES

1. **UNIT I:**
   https://en.wikipedia.org/wiki/Complex_analysis
   UNIT II:
2. https://en.wikipedia.org/wiki/Contour_integration
   http://mathonline.wikidot.com/complex-power-series
   UNIT III:
3. https://en.wikipedia.org/wiki/Normal_distribution
   https://en.wikipedia.org/wiki/Sampling_(statistics)
   https://nptel.ac.in/courses/111104073/
4. **UNIT IV:**
   https://en.wikipedia.org/wiki/Statistical_hypothesis_testing
5. **UNIT V:** https://machinelearningmastery.com/statistical-hypothesis-tests/

HYDRAULICS & HYDRAULIC MACHINERY

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE4T07
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	----------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Get exposure about the applications of Hydraulic Engineering in the field by means of studying the various channels.
2	Learn applications of dimensional analysis
3	Study the effect of impact of jet of water on vanes.
4	Study the suitability of usage of turbines
5	Learn about usage of various pumps

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Study theories those explain the behavior and performance of fluid when the fluid is flowing in an Uniform open channel and non-uniform channels.	K1
CO2	Knowledge on hydraulic similitude of fluids.	K2
CO3	Acquainted with the concept of impact of jets.	K2
CO4	Understand the components, function and use of different types of turbines.	K2
CO5	Understand the components, function and use of different types of pumps.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	--	--	--	--	--	--	--	--	2	--	--	2
CO2	3	2	2	1	--	--	--	--	--	--	--	2	--	--	2
CO3	2	3	2	1	1	--	--	--	--	--	--	2	--	--	1
CO4	2	2	2	1	-	1	1	1	--	--	--	2	--	--	1
CO5	2	2	2	3	1	1	1	--	--	--	--	2	--	--	1

COURSE CONTENT

UNIT I

OPEN CHANNEL FLOW: Types of flows - Type of channels – Velocity distribution – Energy and momentum correction factors – Chezy's, Manning's; Kutter's Equations; and Bazin formulae for uniform flow – Most Economical sections. Critical flow: Specific energy- critical depth – computation of critical depth –critical sub-critical and super critical flow - Hydraulic Jump.

UNIT II

HYDRAULIC SIMILITUDE: Dimensional analysis-Rayleigh's method and Buckingham's pi theorem-study of Hydraulic models – Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations

UNIT III

BASICS OF TURBO MACHINERY: Hydrodynamic force of jets on stationary and moving flat inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for work done and efficiency-Angular momentumprinciple.

UNIT IV

HYDRO ELECTRIC POWER PLANT: Layout of a typical Hydropower installation – Heads and efficiencies - classification of turbines

HYDRAULIC TURBINES: Pelton wheel - Francis turbine – Kaplan turbine - working, working proportions, velocity diagram, work done and efficiency Draft tube-theory & function efficiency, Governing of turbines-surge tanks-unit and specific turbines-unit speed- unit quantity-unit power-specific speed performance characteristics-geometric similarity- Cavitation.

UNIT V

CENTRIFUGAL PUMPS: Pump installation details-classification-work done- Manometric head-minimum starting speed-losses and efficiencies, specific speed, multistage pumps- pumps in parallel-performance of pumps Similarity Considerations. Characteristic curves – NPSH- Cavitations.

RECIPROCATING PUMPS: Introduction, classification of reciprocating pumps, main components of reciprocating pumps, working of a reciprocating pump, discharge through pumps, indicator diagram, work done by reciprocating pumps, slip of reciprocating pumps.

TEXT BOOKS

1. Hydraulics & Fluid Mechanics by P. N. Modi & S. N. Seth; Standard Book house, New Delhi.
2. Fluid Mechanics & Hydraulic Machines by Dr. R. K. Bansal; Laxmi Publications, New Delhi.

REFERENCE BOOKS

1. Hydraulic Machines by Jagadhishlal; Metropoliton Company, Delhi.
2. Fluid Mechanics by A. K. Jain; Khanna Publishers, Delhi.
4. Fluid Mechanics, Thermodynamics of Turbo machinery by S.L. Dixon.

WEB RESOURCES

1. www.nptel.ac.in/courses
2. https://theconstructor.org/

STRUCTURAL ANALYSIS

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE4T08
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Strength of Materials I	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To give preliminary concepts of assessment of bending moment and shear force in Proppedcantilevers, fixed beams and continuous beams due to various loading conditions.
2	To impart concepts of Bending Moment and Shear force for beams with different boundary and Loading conditions
3	The procedure for development of slope deflection equations and to solve application tocontinuous beams with and without settlement ofsupports.
4	The concepts of moving loads and influence lines are imparted for assessment of maximum SF andBM at a given section when loads of varying spans rolling loads of Pratt and Warren trusses.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Distinguish between the determinate and indeterminate structures. Identify the behaviour of structures due to the expected loads, including the moving loads, acting on thestructure.	K2
CO2	Estimate the bending moment and shear forces in beams for different fixity conditions.	K2
CO3	Analyze the continuous beams using various methods -, three moment method, slope deflection method, energytheorems.	K2
CO4	Draw the influence line diagrams for various types of moving loads on beams/bridges.	K3
CO5	Analyze the loads in Pratt and Warren trusses when loads of different types and spans are passing over thetruss.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO2	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO3	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO4	3	3	2	2	-	-	-	-	2	-	-	-	3	-
CO5	3	3	2	2	-	-	-	-	2	-	-	-	3	-

COURSE CONTENT

UNIT I-

PROPPED CANTILEVERS: Analysis of propped cantilevers-shear force and bendingmoment diagrams-Deflection of propped cantilevers.

FIXED BEAMS: Introduction to statically indeterminate beams with udl, central pointload, eccentric point load, Number of point loads, uniformly varying load, couple andcombination of loads shear force and bending moment diagrams-Deflection of fixedbeams effect of sinking of support, effect of rotation of a support.

UNIT II

SLOPE-DEFLECTION METHOD: Introduction, derivation of slope-deflection equation,application to continuous beams with and without settlement of supports. Analysis of Single bay Singlestorey portal frames without Sway, S.F.D and B.M.D, Elastic curves.

UNIT III

MOMENT DISTRIBUTION METHOD: Application to continuous beams with and without settlement of supports. Analysis of Single Bay single storey portal frames without sway. Shear force and Bending moment diagrams, Elastic curve.

UNIT – IV

MOVING LOADS AND INFLUENCE LINES: Introduction maximum SF and BM at a given sectionand absolute maximum S.F. and B.M due to single concentrated load, U. D load longer than the span, U. D load shorter than the span, two-point loads with fixed distance between them and several point loads-Equivalent uniformly distributed load-Focal lengths.

Definition of influence line for SF, Influence line for BM- load position for maximum SF at a section-Load position for maximum BM at a section, single point load, U.D. load longer than the span, U.D. load shorter than the span- Influence lines for forces in members of Pratt and Warren trusses.

UNIT – V

MATRIX METHODS OF ANALYSIS: Introduction to Flexibility and Stiffness matrix methods of analyses using 'system approach' upto three degree of indeterminacy– Analysis of continuous beams including settlement of supports using flexibility and stiffness methods - Analysis of pin-jointed determinate plane frames using flexibility and stiffness methods- Analysis of single bay single storey portal frames using only stiffness method - Shear force and bending moment diagrams - Elastic curve.

TEXT BOOKS

1. Analysis of Structures- Vol. I and II, V. N. Vazirani and M. M. Ratwani, Khanna Publishers, New Delhi.
2. Analysis of Structures by T.S. Thandavamoorthy, Oxford University Press, New Delhi.

REFERENCE BOOKS

1. Theory of Structures by S.Ramamrutham& R. Narayan, Dhanpat Rai Publishing Company.
2. Theory of Structures by R.S. Khurmi, S. Chand Publishers.
3. C. S. Reddy, Basic Structural Analysis, Tata McGraw Hill.

WEB RESOURCES

1. https://nptel.ac.in/courses/105105166/
2. https://cosmolearning.org/courses/structural-analysis-video-lessons/video-lectures/
3. http://www.nptelvideos.in/2012/11/structural-analysis-ii.html

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course Category	Humanities including Management	**Course Code**	20HM4T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: The student able to	
1	Make use of the concepts of managerial economics and demand in managerial decision making and predicting demand for goods and services
2	Assess the functional relation among production, cost of production, cost concepts and Break-Even Analysis.
3	Classify market structures for price and output decisions and Appraise the forms of business organizations and trade cycles in economic growth.
4	Make use of the final accounting statements in financial decision making
5	Apply capital budgeting techniques in financial decision making

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Make use of the concepts of managerial economics and demand in managerial decision making and predicting demand for goods and services	K3
CO2	Assess the functional relation among production, cost of production, cost concepts and Break-Even Analysis.	K5
CO3	Classify market structures for price and output decisions and Appraise the forms of business organizations and trade cycles in economic growth.	K2
CO4	Make use of the final accounting statements in financial decision making	K2
CO5	Apply capital budgeting techniques in financial decision making	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	0	2	0	0	0	0	0	0	0	0	0	0	-	-
CO2	0	1	0	0	0	0	0	0	0	0	3	0	-	-
CO3	0	1	0	0	0	0	0	0	2	0	0	1	-	-
CO4	0	0	0	0	0	0	0	0	0	0	3	2	-	-
CO5	0	3	0	0	0	0	0	0	0	0	3	2	-	-

COURSE CONTENT

Unit – I

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Basic Economic Tools used in Managerial Economics-Concepts of Demand-Types-Determinants-Law of Demand its Exceptions-Elasticity of Demand-Types and Measurement- Demand forecasting and Methods of demand forecasting (Opinion survey methods, Trend line by observation, least squares method and barometric techniques)

Unit – II

Production and Cost Analysis: Production function- Law of Variable proportions- Iso-quants and Isocosts- Laws of Returns to Scale-Cobb-Douglas Production function-Economies of Scale-Cost Concepts- Fixed vs Variable Costs-Out of Pocket Costs vs Imputed Costs-Cost Volume Profit analysis-Determination of Break- Even Point (Simple Problems).

Unit – III

Introduction to Markets, Pricing Policies and Types of Business Organizations: Market Structures: Perfect Competition, Monopoly, Monopolistic and Oligopoly – Features – Price and Output Determination. **Pricing Policies**: Methods of Pricing: Limit Pricing, Market Skimming Pricing, Internet Pricing: Flat Rate Pricing, Usage sensitive, Transaction based pricing, Priority Pricing.

Types of Business Organization and Business Cycles: Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms – Business Cycles – Meaning and Features – Phases of Business Cycles.

Unit – IV

Introduction to Accounting and Capital Budgeting: Introduction to Double Entry Systems-Journal-Ledger- Trail Balance - Preparation of Final Accounts (Simple Problems).

Unit – V

Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods(Simple Problems)

TEXT BOOKS

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis – TMH- 2018.
2. Dr. N. Appa Rao, Dr. P. Vijay Kumar - 'Managerial Economics and Financial Analysis' - Cengage Publications – 2012

REFERENCE BOOKS

1. V. Maheswari -Managerial Economics - Sultan Chand & Sons – 2014.
2. Suma Damodaran - Managerial Economics - Oxford - 2011.

WEB RESOURCES

1. https://economictimes.indiatimes.com/definition/law-of-supply
2. https://sites.google.com/site/economicsbasics/managerial-theories-of-the-firm

ENGINEERING GEOLOGY LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE4L04
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: The student able to	
1	Sedimentary processes (Weathering, erosion, deposition), Metamorphism and volcanic eruptions.
2	Identification of the minerals types of clay minerals their properties and effects on engineering project.
3	Types of rock (Igneous, Sedimentary, and Metamorphic), Civil engineering importance of rock forming minerals.
4	Understand metal forming processes and joining processes.
5	Geological structures (Joint, veins, crack, faults, and fold), reasons of formation for each type and their side effects on the engineering projects.
6	Origin, Internal and surface structures of the eart.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Identify the minerals and their properties.	K3
CO2	Recognize the rocks and their properties.	K3
CO3	Determine the behaviour of the bedding planes in terms of solving strike and dip.	K5
CO4	Draw sections for geological maps showing tilted beds and faults.	K6
CO5	Identify the morphological and geological characteristics on maps.	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	3	-	-	2	3	-
CO2	3	3	1	2	-	-	-	-	2	-	-	2	3	-
CO3	3	-	-	2	-	-	-	-	3	-	-	-	2	-
CO4	3	3	1	3	3	-	-	-	3	-	-	2	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	3	2

COURSE CONTENT

2. Physical properties of minerals: Mega-scopic identification
3. Rock forming minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
4. Ore forming minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite.
5. Megascopic description and identification of rocks.
6. Igneous rocks – Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt, etc
7. Sedimentary rocks – Sand stone, Ferrugineous sand stone, Lime stone, Shale, Laterite, Conglamorate etc.
8. Metamorphic rocks – Biotite – Granite Gneiss, Slate, Muscovite &Biotiteschist, Marble, Khondalite, etc

9. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
10. Simple Structural Geology problems.
11. Bore-hole data.
12. Strength of the rock using laboratory tests.
13. Field work – To identify Minerals, Rocks, Geomorphology& Structural Geology.

Note: Any 10 experiments are to be conducted among 12

TEXT BOOKS

1. Engineering Geology' by N. ChennaKesavulu, Trinity Press (Laxmi Publications), 2nd Edition, 2014.
2. Engineering Geology' by SubinoyGangopadhay, Oxford University press

REFERENCE BOOKS

1.Engineering Geology for Civil Engineers by P.C. Varghese, PHI learning pvt. Ltd.
2.Fundamentals of Engineering Geology' by P.G. Bell, B.S.P. Publications, 2012**.**

WEB RESOURCES

3. https://nptel.ac.in/courses/105105106/

FLUID MECHANICS & HYDRAULIC MACHINERY LABORATORY

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core Course (Lab)	**Course Code**	20CE4L05
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To know the knowledge of various flow meters and the concept of fluid mechanics. Students will compare the performance of various machines at different operating points.
2	To understand the flow through different channels in Practical conditions.
3	Useful to learn the Bernoulli's Equation Practical Applications.
4	Can understand the different hydraulic turbines in power plants.
5	This lab helps to gain knowledge on working of centrifugal pumps, positive displacement pumps.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Perform experiments to determine the coefficient of discharge of flow measuring devices.	K2
CO2	Analyze the flow through rectangular and v-notch and pipe flow losses.	K4
CO3	Verify the Bernoulli's theorem and knowledge on impact of jets.	K2
CO4	Conduct experiments on hydraulic turbines and pumps to draw characteristics.	K2
CO5	Examine the centrifugal and reciprocating pumps.	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	--	--	1	--	--	--	--	--	--	1	3	1
CO 2	3	2	2	--	--	1	--	--	--	--	--	--	1	3	1
CO 3	3	2	2	--	--	1	--	--	--	--	--	--	1	3	1
CO 4	3	2	2	--	--	1	--	--	--	--	--	--	1	3	1
CO 5	3	2	2	--	--	1	--	--	--	--	--	--	1	3	1

COURSE CONTENT

List of Experiments:

1. Calibration of Venturimeter& Orifice meter.
2. Determination of Coefficient of discharge for a small orifice by a constant headmethod.
3. Determination of Coefficient of discharge for an external mouth piece by variablehead method.
4. Calibration of contracted Rectangular Notch and /or Triangular Notch.
5. Determination of Coefficient of loss of head in a sudden contraction and frictionfactor.
6. Verification of Bernoulli's equation.
7. Impact of jet on vanes.

8. Study of Hydraulic jump.
9. Performance test on Pelton wheel turbine.
10. Performance test on Francis turbine.
11. Efficiency test on centrifugal pump.
12. Efficiency test on reciprocating pump.

List of Equipment:

1. Venturimeter setup.
2. Orifice meter setup.
3. Small orifice setup.
4. External mouthpiece setup.
5. Rectangular and Triangular notch setup.
6. Friction factor test setup.
7. Bernoulli's theorem setup.
8. Impact of jets.
9. Hydraulic jump test setup
10. Pelton wheel and Francis turbines.
11. Centrifugal and Reciprocating pumps.

TEXT BOOKS

1. Fluid Mechanics and Hydraulic Machines by R. K. Bansal; Laxmi Publications; New Delhi.
2. Hydraulics & Fluid Mechanics by P. N. Modi & S. N. Seth; Standard Book house, New Delhi.

REFERENCE BOOKS

1. Rajput R.K., Fluid Mechanics and Hydraulic Machines, S.Chand and Company Ltd., 2005.

WEB RESOURCES

1. http://www.nptelvideos.in/2012/11/fluid-mechanics.html
2. https://nptel.ac.in/courses/105101001/

CONCRETE TECHNOLOGY LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE4L06
Course Type	Laboratory	**L-T-P-C**	0-0-3-1.5
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: The student able to	
1	Preparation of samples of structural concrete to test and analyze its behavior and strength characteristic by various tests.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Outline the importance of testing of cement and its properties	K2
CO2	Assess the different properties of aggregate	K4
CO3	Summarize the concept of workability and testing of concrete	K3
CO4	Describe the preparation of green concrete	K2
CO5	Describe the properties of hardened concrete	K2

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	3	-	-	2	3	-
CO2	3	3	1	2	-	-	-	-	2	-	-	2	3	-
CO3	3	-	-	2	-	-	-	-	3	-	-	-	2	-
CO4	3	3	1	3	3	-	-	-	3	-	-	2	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	3	2

COURSE CONTENT

I. Test on Cement

1. Normal Consistency and fineness of cement.
2. Initial setting time and final setting time of cement.
3. Specific gravity of cement
4. Soundness of cement
5. Compressive strength of cement

II. Test on Aggregates (Coarse and Fine)

1. Specific gravity (Pycnometer),water absorption
2. Shape(Flakiness and elongation indices)
3. Bulking of sand, Bulk and compact densities of fine and coarse aggregates

III. Test on Fresh Concrete

1. Slump Test
2. Compaction Factor Test

3. Vee-bee Consistometer Test

IV. Test on hardened concrete

1. Compression test on cubes & Cylinders
2. Flexure test
3. Split Tensile Test

Note: Any 10 experiments are to be conducted among 14

TEXT BOOKS

1. Concrete Technology by M.S. Shetty – S. Chand & Co.
2. Concrete Manual by M.L. Gambhir, Dhanpat Rai & Sons

REFERENCE BOOKS

1. Concrete Manual by M.L. Gambhir, Dhanpat Rai & Sons
2. Highway Material Testing manual, Khanna, Justo and Veeraraghavan, Nemchand Brothers

SKILL ORIENTED COURSE

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Skill Oriented Course	**Course Code**	20CE4S02
Course Type	-------	**L-T-P-C**	1-0-2-2
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

Road safety audit with 1 or 2 KM length or

DESIGN & DRAWING OF REINFORCED CONCRETE STRUCTURES

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE5T09
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Building Materials and Concrete Technology	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To gain the knowledge about the behavior of reinforced concrete elements and load transferring system.
2	To understand the different types of design philosophies and with concepts of design of flexural members.
3	To understand the concepts of Shear, Torsion and Bond.
4	To understand the different types of Compression members and their designs and different types of footings and their design.
5	To understand the different types of Slabs and their designs, gain the knowledge about different types of loads on structures and different codes of practice.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Identify the methods which are suitable for particular structures.	K2
CO2	Carryout analysis and design of flexural members and detailing.	K4
CO3	Design concepts of Shear, Torsion and Bond.	K3
CO4	Design the Short and Long columns with desirable loading conditions. Determine the dimensions of the footing with desirable loading conditions.	K3
CO5	Design the Slabs with desirable loading conditions.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of program															
Outcomes (1 - Low, 2- Medium, 3-High)															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO2	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO3	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO4	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO5	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1

COURSE CONTENT	
UNIT-I	**INTRODUCTION:** Working stress method design codes and handbooks, Loading standards – Dead, live, wind and earthquake loads, Elastic theory, Design constants, Modular ratio, Neutral axis depth and Moment of resistance, Balanced, Under-reinforced and Over-reinforced sections, Working stress method of design for singly and doubly reinforced beams. **LIMIT STATE DESIGN**: Concepts of limit state design – Basic statistical principles – Characteristic loads –Characteristic strength – Partial load and safety factors – Representative stress-strain curves for cold worked deformed bars and mild steel bars. Assumptions in limit state design – Stress-block parameters – limiting moment of Resistance.
UNIT-II	**DESIGN FOR FLEXURE:** Limit state analysis and design for singly reinforced sections-effective depth- Moment of Resistance- Doubly reinforced beams - Flanged (T and L) beam sections- Minimum depth for a given capacity- Limiting Percentage of Steel- Minimum Tension Reinforcement-Maximum Flexural Steel- Design of Flanged Sections (T&L)-Effective width of flange –Behaviour- Analysis and Design.
UNIT-III	**DESIGN FOR SHEAR, TORSION AND BOND:** Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length, I.S. code provisions. Design examples in simply supported and continuous beams, detailing. **LIMIT STATE DESIGN FOR SERVICEABILITY:** Deflection, cracking and code provision, Design of formwork for beams and slabs.
UNIT-IV	**DESIGN OF COMPRESSION MEMBERS:** Effective length of a column, Design of short and long columns – under axial loads, Uni-axial bending and biaxial bending – Braced and Un-braced columns – I S Code provisions. **FOOTINGS:** Different types of footings-Bearing capacity of soils – rectangular and circular footings subjected to axial loads, Uni-axial and bi-axial bending moments.
UNIT-V	**SLABS:** Classification of slabs, Design of one - way slabs, two - way slabs and continuous slabs using IS Coefficients (conventional).

NOTE: All the designs should teach in Limit State Method. Following plates should be prepared by the students.

1. Reinforcement particulars of T-beams and L-beams.
2. Reinforcement detailing of Continuous beams.
3. Reinforcement particulars of Columns and Footings.
4. Detailing of One way, Two way and Continuous slabs.

INTERNAL EXAMINATION PATTERN:

The total internal marks (30) are distributed in two components as follows:

1. Descriptive (subjective type) examination: 20marks.
2. Plates (Drawing sheets): 5marks
3. Assignment: 5marks

FINAL EXAMINATION PATTERN:

The end examination paper should consist of Part A and Part B. part A consist of two questions in Design and Detailing, out of which one question is to be answered. Part B should consist of five questions and out of which three questions to be answered. Weightage for Part – A is 40% and Part- B is 60%.

TEXT BOOKS	
1.	Limit State Design by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi, publications Pvt. Ltd., New Delhi,Laxmi Publications Pvt Ltd; 1st edition (2007).
2.	Reinforced concrete design by S. Unnikrishna Pillai & Devdas Menon, TataMc.Graw Hill, NewDelhi,3rd edition (2017) .
REFERENCE BOOKS	
1.	Design of concrete structures – Arthus H.Nilson, David Darwin, and Chorles W. Dolar, Tata Mc.Graw-Hill,3rd Edition,2005.
2.	Reinforced concrete structures, Vol.1, by B.C.Punmia, Ashok Kumar Jain andArun Kumar Jain, Laxmi, publications Pvt.Ltd., NewDelhi. Seventh edition (1 January 1992)
WEB REFERENCES	
1.	https://www.digimat.in/nptel/courses/video/105105105/L18.html

IS Codes:

1. IS-456-2000 (Permitted to use in examination hall)
2. IS-875 part (I, II, III,IV)
3. SP-16 (Permitted to use in examination hall)

GEOTECHNICAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE5T10
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	-----	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE LEARNING OBJECTIVES	
1	To Enable the Knowledge of availability,types, index Properties of soils and classify it.
2	To impart the concept of permeability and seepage of water through soils for better understanding the discharge of water through different types of soils.
3	To interpolate the student to understand the concept of stress induced and to determine various parameters.
4	To make the students understand the principles of compaction & consolidation and determine the magnitude and the rate of consolidation settlement.
5	To Impart the concept of shear strength of soils, determine the shear parameters of sands and clays and the areas of their application.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Demonstrate the various quantities related to soil mechanics, establish their inter-relationships and their classification.	K2
CO2	Apply the concept of seepage through soil to construct the flow net for water flow calculations	K3
CO3	Examine the stress distribution under the loads.	K4
CO4	Know the importance of the different engineering properties of the soil such as compaction, permeability, consolidation and determine them in laboratory	K3
CO5	Measure shear strength parameters for field conditions	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	2	3	2	1	1	1	1	2	3	3	3	2
CO2	2	3	3	2	2	1	1	1	1	1	2	3	2	2	3
CO3	3	3	2	2	2	1	1	1	1	1	1	3	2	3	2
CO4	3	3	2	2	2	2	1	2	1	1	2	3	2	3	2
CO5	2	3	3	3	1	1	1	2	1	2	1	3	2	3	2

COURSE CONTENT	
UNIT I	**Introduction:** Soil formation – soil structure and clay mineralogy – Adsorbed water – Mass-volume relationship –Relative density **Index Properties of Soils:** Grain size analysis – Sieve and Hydrometer methods – consistency limits and indices – Various Types of soil Classifications – Unified soil classification and I.S. Soil classification.
UNIT II	**Permeability:** Soil water – capillary rise – One dimensional flow of water through soils – Darcy's law- permeability – Factors affecting –laboratory determination of coefficient of permeability – Permeability of layered systems. **Geo static Stresses:** Total, neutral and effective stresses –quick sand condition **Seepage:**2-D flow and Laplace's equation - Seepage through soils –Flow nets: Characteristics and Uses.
UNIT III	**Stress Distribution In Soils:** Stresses induced by applied loads - Boussinesq's and Westergaard's theories for point loads and areas of different shapes– Newmark's influence chart – 2:1 stress distribution method.
UNIT IV	**Compaction:** Mechanism of compaction – factors affecting – effects of compaction on soil properties - compaction control. **Consolidation:** Compressibility of soils – e-p and e-log p curves – Stress history – Concept of consolidation - Spring Analogy - Terzaghi's theory of one-dimensional Consolidation – Time rate of consolidation and degree of consolidation – Determination of coefficient of consolidation (C_v) - Over consolidated and normally consolidated clays.
UNIT V	**Shear Strength of Soils:** Basic mechanism of shear strength -Mohr – Coulomb Failure theories – Stress-Strain behavior of Sands - Critical Void Ratio – Stress-Strain behavior of clays – Shear Strength determination- various drainage conditions.

TEXT BOOKS	
1.	B.M Das, "Principles of Geotechnical Engineering", 7th edition 2013, Cengage Publications.
2.	" An introduction to Geotechnical Engineering" by Holtz and Kovacs; Prentice Hal,lPearson Education India; 2nd edition (2013)
3.	"Soil Mechanics and Foundation Engineering" by V.N.S.Murthy, CBS Publishers.
REFERENCE BOOKS	
1.	"Soil Mechanics and Foundation Engineering" by B.C.Punmia; Laxmi Publications, Delhi,17 th edition 2017.

2.	Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) ,3rd edition 2016.
WEB RESOURCES	
1.	https://archive.nptel.ac.in/courses/105101201/
2.	https://archive.nptel.ac.in/courses/105105168/

HIGHWAY ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional course	**Course Code**	20CE5T11
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Surveying	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To introduce the students with the principles and practice of transportation engineering which focuses on Highway Engineering.
2	Ability to mathematically develop and interpret design standards for horizontal and vertical geometry and super elevation
3	To provide basic knowledge on materials used in pavement construction.
4	To enable the students to have a strong analytical and practical knowledge of Planning, Designing of Pavements.
5	To provide basic knowledge in traffic engineering, and transportation planning.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Plan highway network for a given area.	K3
CO2	Design the Highway geometrics based on highway alignment.	K3
CO3	Characterize the pavement materials like aggregates, Bituminous materials &construction.	K2
CO4	Judge suitability of pavement materials and design flexible and rigid pavements.	K5
CO5	Design Intersections and prepare traffic management plans.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-

COURSE CONTENT	
UNIT I	**Highway Planning and Alignment:** Highway development in India; Classification of Roads; Road Network Patterns; Necessity for Highway Planning; Different Road Development Plans – First, second, third road development plans, road development vision 2021, Rural Road Development Plan – Vision 2025; Planning Surveys; Highway Alignment- Factors affecting Alignment- Engineering Surveys – Drawings and Reports.
UNIT II	**Highway Geometric Design:** Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements-Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance- Design of Horizontal Alignment- Design of Super elevation and Extra widening- Design of Transition Curves-Design of Vertical alignment- Gradients- Vertical curves.
UNIT III	**Highway Materials:** Sub-grade soil: classification –Group Index – Subgrade soil strength – California Bearing Ratio – Modulus of Subgrade Reaction. Stone aggregates: Desirable properties – Tests for Road Aggregates – Bituminous Materials: Types – Desirable properties -Tests on Bitumen .
UNIT IV	**Design of Pavements:** Types of pavements; Functions and requirements of different components of pavements; Design Factors **Flexible Pavements:** Design factors – Flexible Pavement Design Methods – CBR method – IRC method – Burmister method – Mechanistic method – IRC Method for Low volume Flexible pavements. **Rigid Pavements:** Design Considerations – wheel load stresses – Temperature stresses – Frictional stresses – Combination of stresses – Design of slabs – Design of Joints – IRC method – Rigid pavements for low volume roads – Continuously Reinforced Cement Concrete Pavements – Roller Compacted Concrete Pavements.
UNIT V	**Traffic Engineering:** Basic Parameters of Traffic-Volume, Speed and Density- Traffic Volume Studies; Speed studies –spot speed and speed & delay studies; Parking Studies; Road Accidents- Causes and Preventive measures - Condition Diagram and Collision Diagrams; PCU Factors, Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Types of Intersections; At-Grade Intersections – Design of Plain, Flared, Rotary and Channelized Intersections; Design of Traffic Signals –Webster Method –IRC method.

TEXT BOOKS	
1.	Highway Engineering' by Paul H. Wright and Karen K Dixon, Wiley India (P)Ltd., New Delhi,John Wiley & Sons; 7th Edition (2003)
2.	Highway Engineering' by Khanna S.K., Justo C.E.G and Veeraragavan A, Nem Chand Bros,10th Edition (2005), Roorkee.
REFERENCE BOOKS	
1.	Transportation Engineering and Planning' by Papacostas C.S. and PD Prevedouros, Prentice Hall ofIndia Pvt. Ltd;Pearson; 3rd edition (2000), New Delhi.
2.	'Highway Engineering' by Srinivasa Kumar R, Universities Press (India) Private Limited (16 December 2020),Hyderabad.
WEB RESOURCES	
1.	https://nptel.ac.in/downloads/105101087/

RENEWABLE ENERGY ENGINEERING

(Open Elective – I offered by other departments)

Course Category	Professional Core Courses	**Course Code**	20EE5T13
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	**NIL**	**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
1	To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics
2	To understand the concept of Wind Energy Conversion & its applications
3	To study the principles of biomass and geothermal energy
4	To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves and power associated with it
5	To study the various chemical energy sources such as fuell cell and hydrogen energy along with their operation and equivalent circuit

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage	K4
CO2	Illustrate the components of wind energy systems	K3
CO3	Illustrate the working of biomass, digesters and Geothermal plants	K3
CO4	Demonstrate the principle of Energy production from OTEC, Tidal and Waves	K3
CO5	Evaluate the concept and working of Fuel cells & MHD power generation	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	-	-	1	-	-	-	-	1	2	2
CO2	3	2	1	1	-	-	1	-	-	-	-	1	2	2
CO3	3	1	1	1	-	-	1	-	-	-	-	1	2	2
CO4	3	1	1	1	-	-	1	-	-	-	-	1	2	2
CO5	3	1	1	1	-	-	1	-	-	-	-	1	2	2

COURSE CONTENT	
UNIT 1	**Solar Energy:** Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating

	collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.
UNIT 2	**Wind Energy**: Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.
UNIT 3	**Biomass and Geothermal Energy:** **Biomass:** Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant **Geothermal Energy**: Introduction, Geothermal Sources – Applications - operational and Environmental problems.
UNIT 4	**Energy From oceans, Waves & Tides:** **Oceans:** Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India. **Waves:** Introduction - Energy and Power from the waves - Wave Energy conversion devices. **Tides:** Basic principle of Tide Energy -Components of Tidal Energy.
UNIT 5	**Chemical Energy Sources:** **Fuel Cells**: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications. **Hydrogen Energy:** Introduction - Methods of Hydrogen production - Storage and Applications **Magneto Hydro Dynamic (MHD) Power generation:** Principle of Operation - Types.

TEXT BOOKS	
1	G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011
2	John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013
REFERENCE BOOKS	
1	S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011
2	John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013
3	Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/121/106/121106014/
2	https://nptel.ac.in/courses/103/107/103107157/

OPERATIONS RESEARCH
(Open Elective – I offered by other departments)

Course Category	Open Elective	**Course Code**	20ME5T21
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Applications of operations research through LPP.
2	Formulation of objective function through transportation and assignment problems.
3	How to sequence the jobs and machines while processing and Replacement of machine/equipment.
4	The applications of waiting line problems and operations research through DPP.
5	Deterministic and stochastic models.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Formulate the objective function by linear programming problem and solution through various models.	K3
CO2	Evaluate optimal solutions to the objective function with the knowledge of transportation and assignment problems.	K3
CO3	Apply the sequencing of the jobs on a machine and items replacements	K4
CO4	Apply the principle of dynamic programming and service rate.	K3
CO5	Apply the inventory models in balancing the stock and demand ratio for profits	K3

K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	-	-	-	3	-	3	1
CO2	3	3	3	1	3	-	-	-	-	-	3	-	3	1
CO3	3	3	3	1	3	-	-	-	-	-	3	-	3	1
CO4	3	3	3	2	3	-	-	-	-	-	3	-	3	2
CO5	3	3	3	1	3	-	-	-	-	-	3	-	3	2

COURSE CONTENT

UNIT I

INTRODUCTION: Development – definition– characteristics and phases – types of operation research models – applications.

ALLOCATION: Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle

UNIT II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy,

ASSIGNMENT PROBLEM – formulation – optimal solution - variants of assignment problem- travelling salesman problem.

UNIT III

SEQUENCING – Introduction – flow –shop sequencing –*n* jobs through two machines – *n* jobs through three machines – job shop sequencing – two jobs through 'm' machines.

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT IV

WAITING LINES: Introduction – single channel – poison arrivals –exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

UNIT V

INVENTORY: Introduction – single item – deterministic models –purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

TEXT BOOKS

1. Operations Research / S.D.Sharma-Kedarnath
2. Operations Research/S Kalavathy / Vikas Publishers

REFERENCE BOOKS

1. Operations Research / A.M.Natarajan, P. Balasubramani, A.Tamilarasi / Pearson Education.
2. Operations Research / R.Pannerselvam,PHI Publications.
3. Operations Research / Wagner/ PHI Publications.
4. Operations Research / DS Cheema/University Science Press
5. Operations Research / Ravindran, Philips, Solberg / Wiley publishers.

WEB RESOURCES

1. http://www.nptelvideos.in/2012/12/fundamentals-of-operations-research.html
2. https://nptel.ac.in/courses/110106062

PRINCIPLES OF COMMUNICATION ENGINEERING
(Open Elective – I offered by other departments)

Course Category	Open Elective	**Course Code**	20EC5T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Signals and Systems	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
The student will learn	
1	The Fundamentals of Analog Communication Systems
2	The Generation and Detection of Angle Modulation Techniques
3	The Digital Modulation Techniques
4	The knowledge in measurement of information and various codes for communication systems
5	Fundamentals of Microwave, Satellite, Optical and Mobile Communications

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the basics of Analog communication system	K2
CO2	Understand the Angle Modulation Techniques	K2
CO3	Understand the basics of Analog communication system	K2
CO4	Apply the knowledge of digital electronics and understand the error control coding techniques.	K3
CO5	Understand different types of communication systems and its requirements.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Basic blocks of Communication System**. Analog Modulation-Principles of Amplitude Modulation, DSBSC, SSB-SC and VSB-SC, AM transmitters and receivers
UNIT II	**Angle Modulation-Frequency and Phase Modulation**. Transmission Band width of FM signals, Methods of generation and detection, FM Transmitters and Receivers.
UNIT III	**Sampling theorem, Pulse Modulation Techniques**-PAM, PWM and PPM concept ,PCM System, Delta Modulation, Digital Modulation Techniques-(ASK, FSK, PSK, QPSK).
UNIT IV	**Error control coding techniques**–Basics of Information Theory, Linear block

	codes-Encoder and decoder, Hamming Code, Cyclic codes–Encoder, Syndrome Calculator, Convolution codes.
UNIT V	**Modern Communication Systems–**Microwave communication systems, Optical communication system, Satellite communication system, Mobile communication system.

TEXT BOOKS	
1	Communication Systems (Analog And Digital) | Sanjay Sharma, S.K.Kataria& Sons, 2013
2	CommunicationSystems,SimonHaykins,JohnWiley,3rdEdition,1995
REFERENCE BOOKS	
1	Shulin Daniel, 'Error Control Coding', Pearson, 2ndEdition,2011.
2	B.P.Lathi and ZhiDing, 'Modern Digital and Analog Communication Systems', OUPUSA Publications, 4thEdition,2009.
WEB RESOURCES	
1	https://nptel.ac.in/courses/117105143/15
2	http://www.nptelvideos.in/2012/12/digital-communication.html

DEEP LEARNING

(Open Elective – I offered by other departments)

Course Category	Professional Core	**Course Code**	20AM5T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Machine Learning	**Internal Assessment Semester** **End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
The student will:	
1	Learn deep learning methods for working with sequential data.
2	Learn deep recurrent and memory networks.
3	Learn deep Turing machines.
4	Apply such deep learning mechanisms to various learning problems.
5	Know the open issues in deep learning, and have a grasp of the current research directions.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.	K1
CO2	Discuss the Neural Network training, various random models**.**	K2
CO3	Explain the Techniques of Keras, Tensor Flow, Theano and CNTK.	K2
CO4	Classify the Concepts of CNN and RNN.	K3
CO5	Implement Interactive Applications of Deep Learning.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	--	--	--	--	--	--	2	2	2	3
CO2	2	2	2	1	1	--	--	--	--	--	--	2	1	1	2
CO3	2	1	1	2	2	--	--	--	--	--	--	1	1	1	2
CO4	2	2	2	1	1	--	--	--	--	--	--	1	1	1	2
CO5	3	2	1	1	1	--	--	--	--	--	--	1	1	1	3

COURSE CONTENT	
UNIT-I	**Fundamentals of Deep Learning**: Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, **Fundamentals of Machine Learning**: Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting

UNIT-II	**Introducing Deep Learning**: Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks.
UNIT-III	**Neural Networks**: Anatomy of Neural Network, Introduction to Keras: Keras, Tensor Flow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews, Binary Classification, Classifying news wires, Multiclass Classification
UNIT-IV	**Convolutional Neural Networks**: Nerual Network and Representation Learning, Convolutional Layers, Multichannel Convolution Operation. **Recurrent Neural Networks**: Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch.
UNIT-V	**Interactive Applications of Deep Learning**: Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. **Deep Learning Research**: Auto encoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines,Deep Belief Networks.

TEXT BOOKS	
1.	Deep Learning-Ian Good fellow, Yoshua Bengio and Aaron Courvile, MIT Press,2016
2.	Deep Learning with Python-Francois Chollet, Released December 2017, Publisher(s):Manning Publications, ISBN:9781617294433.
REFERENCE BOOKS	
1.	Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional,ISBN:9780135116821
2.	Deep Learning from Scratch-Seth Weidman, Released September 2019, Publisher(s) :O'Reilly Media, Inc., ISBN:9781492041412
3.	Artificial Neural Networks, Yegnanarayana,B.,PHILearningPvt.Ltd,2009.
4.	Matrix Computations, Golub,G.,H.,andVanLoan,C.,F,JHUPress,2013.
5.	NeuralNetworks: A Classroom Approach, Satish Kumar, TataMcGraw-HillEducation,2004.
WEB RESOURCES:	
1	SwayamNPTEL:DeepLearning:https://onlinecourses.nptel.ac.in/noc22_cs22/preview

ENTREPRENEURSHIP
(Open Elective – I offered by other departments)

Course Category	Humanities including Management	**Credits**	3
Course Type	Theory	**Lecture-Tutorial-Practice**	3 -0 -0
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

Course Outcomes		**Blooms Taxonomy Level**
On successful completion of the course, the student will be able to		
CO 1	Understand different Entrepreneurial traits.	K2
CO 2	Identify and compare the financial institutions supporting entrepreneurship.	K4
CO 3	Understand the functioning and problems faced by MSMEs (Micro Small Medium Enterprises)	K2
CO 4	Identify Entrepreneurial opportunities for women.	K3
CO 5	Analyze different market, technical factors and prepare a project report based on guidelines.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program												
Outcomes: 1 – Low, 2 - Medium, 3 – High												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	0	0	0	0	1	0	3	2	1	3	3
CO2	0	0	0	0	0	1	0	3	0	2	3	1
CO3	0	0	0	0	0	1	1	3	1	1	0	3
CO4	0	0	0	0	0	1	0	3	1	1	0	3
CO5	0	1	1	0	0	1	2	3	1	3	3	3

COURSE CONTENT :	
UNIT -I	Introduction to Entrepreneurship Introduction to Entrepreneurship: Definition of Entrepreneur Entrepreneurial Traits. Entrepreneur vs. Manager, Creating and Starting the venture: Sources of new ideas, methods of generating ideas, creative problem solving – Writing Business Plan, Evaluating Business Plans.
UNIT -II	Institutional and financial support to Entrepreneurship Institutional/financial support: Schemes and functions of Directorate of Industries, IFCI, District Industries Centers (DICs), Industrial Development Corporation (IDC), State Financial Corporation (SFCs), Small Scale Industries Development Corporations (SSIDCs). Khadi and Village Industries Commission (KVIC), Technical Consultancy Organization (TCO), Small Industries Service Institute (SISI), National Small Industries Corporation (NSIC), Small Industries Development Bank of India (SIDBI).(short answers only), Start up culture.
UNIT -III	Micro, Small and Medium Enterprises: Importance and role of MSMEs in economic development, Types of MSMEs, Policies and their support to MSMEs growth and growth strategies. Sickness in small business and remedies – small entrepreneurs in International business.

UNIT -IV	Women Entrepreneurship and Start up Culture Role & importance, profile of women Entrepreneur, problems of women Entrepreneurs, women Entrepreneurship Development in India -Steps taken by the Government to promote women entrepreneurship in India, Associations supporting women entrepreneurs. Successful Entrepreneurs (case studies).
UNIT -V	Project Formulation and Appraisal Preparation of Project Report –Content; Guidelines for Report preparation – Project Appraisal techniques –economic – Steps Analysis; Financial Analysis; Market Analysis; Technical Feasibility.

Textbooks:

1. Vasanth Desai – Fundamentals of Entrepreneurship and Small business management – Himalaya publishing house – 2019

2. Robert Hisrich, Michael Peters, Dean A. Sheperd, Sabyasachi Sinha – Entrepreneurship - TMH - 2020.

Reference Books :

1. Vasant Desai – Entrepreneurship Management - Himalaya Publishing House- 2018.

2. Robert J.Calvin - Entrepreneurial Management – TMH - 2009.

3. Gurmeet Naroola - The entrepreneurial Connection – TMH - 2009.

4. ArunaKaulgud - Entrepreneurship Management - Vikas publishing house - 2009.

Web Resources:

1. https://nptel.ac.in/courses/110105067/50
2. http://www.yourarticlelibrary.com/project-management/5-methods-of-project-appraisal-explained/40771
3. https://springhouse.in/government-schemes-every-entrepreneur/

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE5T12
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Building Materials and Concrete Technology	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	Familiarize Students with deterioration of concrete in structures.
2	Equip student with concepts of NDT and evaluation.
3	Understand failures and causes for failures in structures.
4	Familiarize different materials and techniques for repairs
5	Understand procedure to carryout Physical evaluation of buildings and prepare report.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Assess the deterioration of concrete in structures	K1
CO2	Evaluate structures by NDT	K4
CO3	Assess failures and causes of failures in structures.	K4
CO4	Applying repair and rehabilitation techniques. Carryout Physical evaluation and submit report on condition of the structure.	K3
CO5	Application of materials for repair and rehabilitation.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	-	-	2	-	-	1	1	-	1	-	-	-
CO2	3	2	3	-	-	1	-	-	1	1	-	1	1	1	1
CO3	3	2	3	-	-	1	-	-	1	1	-	1	1	-	2
CO4	2	2	3	-	-	1	-	-	1	1	-	1	-	1	-
CO5	2	2	3	-	-	1	-	-	1	1	-	1	-	2	2

COURSE CONTENT	
UNIT I	**MAINTENANCE AND REPAIR STRATEGIES :** Maintenance Repair and Rehabilitation, Importance of Maintenance, Various aspects of Inspection, Assessment Procedure for evaluating a damaged structure, Deterioration - Causes, Effects, Types of Deterioration- Physical, Chemical, Mechanical, Preventive measures.

UNIT II	**STRENGTH AND DURABILITY OF CONCRETE :** Quality assurance for Concrete - Strength, Durability and Properties of Concrete, Effects of Climate, Temperature, Corrosion, Cover Thickness on Concrete, Non-Destructive Techniques - Rebound hammer, Ultrasonic pulse velocity, Penetration Resistance and Pull out test.
UNIT III	**FAILURE OF STRUCTURES:** Definition of Structural failure, Causes of failures, Types of failures - Faulty Design, Accidental over Loading, Poor quality of material and Poor Construction practices, Fire damage, Cracks - Types, Causes, Methodology for investigation of failures.
UNIT IV	**TECHNIQUES FOR REPAIR AND PROTECTION METHODS :** Repair of Cracks in concrete- Epoxy injection, Jacketing, Underpinning, Shotcreting, and Corrosion protection techniques - Corrosion inhibitors, Corrosion resistant steel, Coating to reinforcement, Cathodic protection, Methods for corrosion measurement by using Corrosion meter test and half-cell potential test.
UNIT V	**REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES :** Strengthening of Structural elements, Repair of Structure, Distressed due to Corrosion, Fire, Leakages, Natural Calamities, Demolition Techniques - Engineering demolition Methods, Case studies

TEXT BOOKS	
1.	Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company 8th Edition, 2019.
2.	B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009
REFERENCE BOOKS	
1.	R. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.
2.	Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD ,Govt of India , New Delhi – 2002
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105103205

ROCK MECHANICS

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE5T13
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Engineering Geology	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE LEARNING OBJECTIVES	
1	To understand rock mass classification (RMR, Q, GSI) and rock mass behaviour (incl. influence of discontinuities on strength, stress distribution and water flow).
2	To understand the basic laboratory in-situ tests, strengths and its responses
3	Ability to understand Engineering properties of rocks, Modes of failure in rock mass
4	To understand Rock slopes and its failures, underground and open excavations and its requirements

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Determine the required rock properties and classify rock mass	K2
CO2	Determination of bearing capacity of rocks,	K2
CO3	Checking the stability of slopes, and design underground and open excavation.	K4
CO4	Predict strength of rock mass with respect to various applications	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	3	1	2	2	1	2	1	1	2	3	3	2
CO2	1	2	2	3	3	2	1	2	2	1	1	2	2	3	2
CO3	2	2	2	2	3	2	1	1	2	1	2	2	2	2	3
CO4	2	2	2	1	1	2	1	2	2	2	2	2	3	3	2

COURSE CONTENT	
UNIT I	**ENGINEERING CLASSIFICATION OF ROCKS:** Classification of intact rocks, Rock mass classifications, Rock Quality Designation (RQD), Rock Structure Rating (RSR), Rock Mass Rating (RMR), Norwegian Geotechnical Classification (Q-system), Strength and modulus from classifications, Classification based on strength & modulus and strength and fracture strain, Geoengineering classification.

UNIT II	**LABORATORY AND IN-SITU TESTING OF ROCKS:** Physical properties, Compressive strength, Tensile strength, Direct shear test, Triaxial shear test, Slake durability test, Schmidt rebound hardness test, Sound velocity test, In-Situ Tests: Seismic methods, Electrical resistivity method, In situ stresses, Plate loading test, Goodman jack test, Plate jacking test, In-situ shear test, Field permeability test.
UNIT III	**STRENGTH, MODULUS AND STRESSES-STRAIN RESPONSES OF ROCKS:** Factors influencing rock response, Strength criteria for isotropic intact rocks, Modulus of intact rocks, effect of confining pressure, Uniaxial Compressive strength, Strength criteria for intact rocks, Strength due to induced anisotropy in rocks,. Stress Strain Models: Constitutive relationships, Elastic, Elasto-plastic, Visco-elastic, Elasto- viscoplastic stress-strain models.
UNIT IV	**INTRODUCTION TO ROCK SLOPES:** Introduction to Rock slopes, Modes of failure, Rotational failure, Plane failure, Design charts, Wedge method of analysis, Buckling failure, Toppling failure, Improvement of slope stability and protection.
UNIT V	**UNDERGROUND AND OPEN EXCAVATIONS:** Blasting operational planning, Explosive products, Blast Design, Underground blast design, Controlled blasting techniques, blasting damage and control, Safe practice with explosives and shots.

TEXT BOOKS	
1.	Singh, B. and Goel, R. K. "Rock Mass Classification Systems – A Practical Approach in Civil Engineering "Elsevier Publisher
2.	Rock mechanics on the design of structures in rock by Oberti and Duvalk, W. L. John Wiley.
REFERENCE BOOKS	
1.	Verma, B. P., "Rock Mechanics for Engineers" Khanna Publishers
2.	Brown, E.T., "Rock Characterisation, Testing and Monitoring", Pergamon Press, London, U.K
WEB RESOURCES	
1.	https://archive.nptel.ac.in/courses/105105212/
2.	https://archive.nptel.ac.in/courses/105107208/

REMOTE SENSING & GIS APPLICATIONS
DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE5T14
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	--	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To understand the basic principles of Remote Sensing and GIS techniques.
2	To learn various types of sensors and platforms.
3	To learn concepts of visual and digital image analyses.
4	To understand the principles of spatial analysis.
5	Appreciate application of RS and GIS to Civil engineering.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Interpret the concepts of Photogrammetric and its applications such as determination of heights of objects on terrain.	K1
CO2	Illustrate the Electromagnetic spectrum and utilize the energy interactions of EMR with atmosphere and earth surface features for GIS data generation.	K1
CO3	Analyze the methods of map projections and understand coordinate systems on GIS Software packages to produce high resolution thematic maps.	K4
CO4	Apply the concepts of vector and raster data model for representation of topological earth features and its importance.	K3
CO5	Apply the RS & GIS techniques for solving Civil engineering applications.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	2	2	-	1	-	-	2	-	2	-	1
CO2	2	1	1	1	2	2	-	1	-	-	2	-	2	-	1
CO3	2	2	-	2	2	2	-	1	-	-	2	--	2	-	1
CO4	2	2	1	2	2	2	-	1	-	-	2	-	2	-	1
CO5	2	3	1	3	2	3	-	1	-	-	2	-	2	-	1

COURSE CONTENT	
UNIT I	INTRODUCTION TO REMOTE SENSING: Basic concepts of remote sensing, electromagnetic radiation, electromagnetic spectrum, interaction with atmosphere, energy interaction with the earth surfaces characteristics of remote sensing systems. SENSORS AND PLATFORMS: Introduction, types of sensors, airborne remote sensing, space borne remote sensing, image data characteristics, digital image data formats-band interleaved by pixel, band interleaved by line
UNIT II	IMAGE ANALYSIS: Introduction, elements of visual interpretations, digital image processing- image pre-processing, image enhancement, image classification, supervised classification, unsupervised classification.
UNIT III	GEOGRAPHIC INFORMATION SYSTEM (GIS): Introduction, key components, application areas of GIS, map projections. Data entry and preparation: spatial data input, raster data models, vector data models.
UNIT IV	SPATIAL DATA ANALYSIS: Introduction, overlay function-vector overlay operations, raster overlay operations, arithmetic operators, comparison and logical operators, conditional expressions, overlay using a decision table, network analysis-optimal path finding, network allocation, network tracing.
UNIT V	RS AND GIS APPLICATIONS GENERAL: Land cover and land use, agriculture, forestry, geology, geomorphology, urban applications APPLICATION TO HYDROLOGY AND WATER RESOURCES: Flood zoning and mapping, groundwater prospects and potential recharge zones, watershed management.

TEXT BOOKS	
1.	Bhatta B (2008), "Remote sensing and GIS", Oxford University Press.
2.	Lillesand, T.M, R.W. Kiefer and J.W. Chipman (2013) "Remote Sensing and Image Interpretation", Wiley India Pvt. Ltd., NewDelhi
REFERENCE BOOKS	
1.	Remote Sensing and its Applications" by Narayan LRA, Universities Press,2012
2.	Fundamentals of Remote Sensing" by George Joseph, Universities Press,2013.
3.	Fundamentals of Geographic Information Systems" by Demers, M.N, Wiley India Pvt. Ltd,2013
4.	Basics of Remote sensing & GIS" by Kumar S, Laxmi Publications, New Delhi, 2005
5.	Principals of Geographical Information Systems" by Burrough P A and R.A. McDonnell, Oxford University Press,1998.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105103193

SOLID HAZARDOUS AND WASTE MANAGEMENT

DEPARTMENT OF DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE5T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	----	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To make the students conversant with the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Knowledge on characteristics of municipal solid wastes.	K2
CO2	Planning on Reduction, reuse and recycling of waste.	K4
CO3	Ability to plan and design systems for storage, collection, transport, processing and disposal of municipal solid waste.	K5
CO4	Knowledge on the issues on solid waste management from an integrated and holistic perspective, as well as in the local and international context.	K2
CO5	Design and operation of sanitary landfill.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of program Outcomes (1 - Low, 2- Medium, 3-High)															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	2	-	2	-	1	2	-	-	-
CO2	3	-	2	-	1	-	2	2	1	-	-	2	2	-	-
CO3	2	1	2	2	-	2	3	-	2	-	1	2	1	2	-
CO4	3	-	2	-	1	-	2	2	1	-	1	2	-	-	1
CO5	2	1	-	-	-	-	3	-	2	-	1	2	1	2	1

COURSE CONTENT	
UNIT-I	**Introduction to Solid Waste Management:** Goals and objectives of solid waste management, Classification of Solid Waste – Factors Influencing generation of solid waste – sampling and characterization –Future changes in waste composition, major legislation, monitoring responsibilities.
UNIT-II	**Basic Elements In Solid Waste Management:** Elements and their inter relationship principles of solid waste management- onsite handling, storage and processing of solid waste Collection of Solid Waste: Type and methods of waste collection systems, analysis of collection system – optimization of collection routes– alternative techniques for collection system.
UNIT-III	**Transfer and Transport:** Need for transfer operation, compaction of solid waste – transport means and methods, transfer station types and design requirements.
UNIT-IV	**Separation and Transformation of Solid Waste**: unit operations used for separation and transformation: shredding – materials separation and recovery, source reduction and waste minimization.
UNIT-V	**Processing and Treatment:** Processing of solid waste – Waste transformation through combustion and composting, anaerobic methods for materials recovery and treatment – Energy recovery – biogas generation and cleaning– Incinerators. **Disposal of Solid Waste:** Methods of Disposal, Landfills: Site selection, design and operation, drainage and leachate collection systems –designated waste landfill remediation.

TEXT BOOKS	
1.	Tchobanoglous, G., Theisen, H. M., and Eliassen, R. "Solid. Wastes: Engineering Principles and Management Issues". McGraw Hill, New York, 1993.
2.	Vesilind, P.A. and Rimer, A.E., “Unit Operations in Resource Recovery Engineering”, Prentice Hall, Inc., 1981
REFERENCE BOOKS	
1.	Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, New Delhi, 2000
2.	Bhide A.D. and Sundaresan, B.B. "Solid Waste Management Collection", Processing and Disposal, 2001
3.	Paul T Willams, "Waste Treatment and Disposal", John Wiley and Sons, 2000
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105103205

CONSTRUCTION TECHNOLOGY AND MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE5T16
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Surveying	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE LEARNING OBJECTIVES	
1	To introduce to the student the concept of project management including network drawing and monitoring.
2	To introduce the various equipment related to construction like earth moving equipment, trucks and handling equipment, aggregate production and construction equipment and machinery.
3	To introduce the importance of safety in construction projects.
4	To introduce the importance of Man power in Construction projects.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Apply the project management techniques for construction planning	K2
CO2	Apply the project management for Solve and upgrade the PERT Technique by using resources in construction	K3
CO3	Plan the suitable equipments in various tasks of projects.	K4
CO4	Apply the safety requirements and quality control aspects in projects	K3
CO5	Planning of Man power and Plan the suitable construction methods for the site execution.	K5
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	2	2	3	1	2	2	3	2	2	1
CO2	3	3	2	2	2	2	2	3	1	2	2	3	2	1	2
CO3	2	3	2	3	3	1	2	3	1	3	2	3	3	3	3
CO4	3	2	3	3	3	1	1	3	1	2	3	3	3	3	2
CO5	3	3	2	2	3	1	1	3	1	2	2	2	3	2	3

COURSE CONTENT	
UNIT I	**CONSTRUCTION PROJECT MANAGEMENT AND ITS RELEVANCE**– qualities of a project manager – project planning – coordination –scheduling - monitoring – bar charts – milestone charts – critical path method.

UNIT II	**PROJECT EVALUATION AND REVIEW TECHNIQUE**– cost analysis - updating – crashing for optimum cost – crashing for optimum resources – allocation of resources.
UNIT III	**CONSTRUCTION EQUIPMENT**– economical considerations – earthwork equipment– Trucks and handling equipment – rear dump trucks – capacities of trucks. Handling equipment – calculation of truck production – compaction equipment – types of compaction rollers. **HOISTING AND EARTHWORK EQUIPMENT**– hoists – cranes – tractors - bulldozers – graders – scrapers– drag lines -clamshell buckets.
UNIT IV	**CONCRETING EQUIPMENT**– crushers – jaw crushers – rotary crushers – impact crushers – selection of crushing equipment - screening of aggregate – concrete mixers – mixing and placing of concrete – consolidating and finishing.
UNIT V	**CONSTRUCTION METHODS**– earthwork – piling – placing of concrete – form work – fabrication and erection – quality control and safety engineering. Man power planning in construction projects.

TEXT BOOKS	
1.	Construction Planning, Equipment and Methods by Peurifoy and Schexnayder, Shapira, Tata M c Graw hill. 7th Edition 2015.
2.	Construction Project Management Theory and Practice by Kumar Neeraj Jha (2011), Pearson. 2nd Edition 2015.
REFERENCE BOOKS	
1.	Construction Project Management - An Integrated Approach by Peter Fewings, Taylor and Francis.
2.	Construction Management Emerging Trends and Technologies by Trefor Williams, Cengage learning.
3.	Construction Technology by Subir K. Sarkar and Subhajit Saraswati, Oxford University press.
4.	Construction project management By K. K Chitkara, Tata M c Graw hill.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/105101008/12/

GEOTECHNICAL ENGINEERING LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core lab	**Course Code**	20CE5L07
Course Type	LAB	**L-T-P-C**	0-0-3-1.5
Prerequisites	------	**Internal Assessment**	15
		Semester End Examination	35
		Total Marks	50

COURSE LEARNING OBJECTIVES	
1	To impart knowledge of determination of index properties required for classification of soils.
2	To teach how to determine compaction characteristics and consolidation behavior from relevant lab tests; to determine permeability of soils.
3	To teach how to determine shear parameters of soil through different laboratory tests.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Determine the dry density of field and OMC.	K3
CO2	Examining the rate of Permeability of soil.	K3
CO3	Identify the type of soil existing in field.	K3
CO4	Evaluate the shear strength parameters from field and laboratory.	K5
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	--	3	--	--	--	--	--	--	--	2	--	3	--	2
CO2	2	--	3	--	--	--	--	--	--	--	2	--	3	--	2
CO3	2	3	3	--	--	--	--	--	--	--	2	--	3	--	2
CO4	2	--	3	--	--	--	--	--	--	--	2	--	3	--	2

LIST OF EXPERIMENTS	
1	Determination of Specific gravity of soil solids, Gs. (IS-2720-Part 3-1980)
2	Determination of soil Atterberg's Limits. (IS-2720-Part 5-1985)
3	Determination of Field density by Core cutter and Sand replacement methods. (IS-2720-Part 28- 1974)
4	Determination of soil Grain size analysis by sieving. (IS-2720-Part 4-1985)
5	Determination of soil Grain size analysis by hydrometer analysis. (IS-2720-Part 4-1985)
6	Determination of Permeability of soil - Constant head test & Variable head test. (IS-2720-Part 17-1986).
7	Determination of dry density and OMC by using Compaction test. (IS-2720-Part 8-1983)
8	Determination of coefficient of consolidation. (IS-8009-Part 1-1976)

9	Determination of Shear strength parameters by using box shear test. (IS-2720-Part 13-1986)
10	Determination of Shear strength parameters by using tri-axial (UU test). (IS-2720-Part11-1993)
11	Determination of Shear strength parameters by using Vane Shear test. (IS-4434-Part 3-1978)
12	Determination of CBR Value. (IS-2720-Part 16-1979)

*Note: At least 10 Experiments has to be completed

S NO.	LIST OF EQUIPMENTS
1	Casagrande's liquid limit apparatus.
2	Apparatus for plastic and shrinkage limits
3	Field density apparatus for Core cutter method
4	Sand replacement testing setup.
5	Set of sieves: 4.75 mm, 2 mm, 1 mm, 0.6 mm, 0.425 mm, 0.3 mm, 0.15 mm, and 0.075 mm.
6	Hydrometer apparatus.
7	Permeability apparatus for Constant head test and Variable head test
8	Apparatus for Compaction test.
9	Apparatus for Consolidation test.
10	Apparatus for Tri-axial test.
11	Apparatus for Vane shear test.
12	Apparatus for CBR test.
13	Apparatus for Box shear test
14	Air-dry oven, Weighing Machine

TEXT BOOKS	
1.	Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) 2006.
2.	"Soil Mechanics - Laboratory manual" by Braja M. Das 6th Edition
REFERENCE BOOKS	
1.	Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2015
2.	IS Code 2720 – relevant parts
WEB RESOURCES	
1.	https://archive.nptel.ac.in/courses/105101160/

TRANSPORTATION ENGINEERING LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core lab	**Course Code**	20CE6L08
Course Type	LAB	**L-T-P-C**	0-0-3-2
Prerequisites	Highway Engineering	**Internal Assessment**	15
		Semester End Examination	35
		Total Marks	50

COURSE LEARNING OBJECTIVES	
1	To study the properties and judge the suitability to use as road materials.
2	To study the properties and stability requirements of the Bitumen mixes.
3	To carry out surveys for traffic volume, speed and parking.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain the bitumen nature and their quality behavior.	K2
CO2	Utilize aggregate and bitumen properties in pavement design.	K3
CO3	Determine the suitability of materials for the road construction.	K2
CO4	Determine the traffic volume, speed and parking characteristics.	K2
CO5	Predict the optimum bitumen content for the mix Design and mix proportions of the bitumen mixes.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	--	3	--	--	2	--	--	--	--	2	--	2	3	3
CO2	3	--	3	--	--	2	--	--	--	--	2	--	2	3	3
CO3	3	--	3	--	--	2	--	--	--	--	2	--	2	3	3
CO4	3	--	3	--	--	2	--	--	--	--	2	--	2	3	3
CO5	3	--	3	--	--	2	--	--	--	--	2	--	2	3	3

LIST OF EXPERIMENTS	
1	**ROADAGGREGATES:** 1. To determine the Aggregate Crushing value. (IS:2386 Part-IV 1963) 2. To determine the Aggregate Impact value. (IS:2386 Part-IV 1963) 3. To determine the specific Gravity and Water Absorption test for aggregates. (IS:2386 Part-III 1963) 4. To conduct the Attrition Test for aggregates. (IS:2386 Part-V 1963) 5. To conduct the Abrasion Test for aggregates. (IS:2386 Part-V 1963) 6. To conduct the Shape tests for aggregates. (IS:2386 Part-I 1963)

2	**BITUMINOUSMATERIALS:** 1. To determine the Penetration value. (IS:1203-1978) 2. To conduct Ductility Test. (IS:1208-1978) 3. To determine the Softening Point. (IS:1205-1978) 4. To determine the Flash and fire point. (IS:1209-1978) 5. To conduct Stripping Test. (IS:6241-1971) 6. To determine the Viscosity. (IS:1206-1978)
3	**BITUMINOUS MIX:** 1. To determine the Marshall Stability Number.
4	**TRAFFIC SURVEYS:** 1. To conduct Traffic volume study at mid-blocks. 2. To conduct Traffic Volume Studies (Turning Movements) at intersection. 3. To conduct Spot speed studies. 4. To conduct Parking study.
5	**DESIGN & DRAWING:** 1. Earthwork calculations for road works. 2. Drawing of road cross sections.

*Note: At least 10 Experiments has to be completed

S NO.	LIST OF EQUIPMENTS
1	Aggregate Crushing Value apparatus
2	Aggregate Impact testing
3	Pycnometer
4	Density Basket
5	Specific Gravity bottle 100ml
6	Deval's Attrition Testing Machine
7	Los Angeles Abrasion Machine with counter
8	Thickness Gauge
9	Length Gauge
10	Bitumen Penetrometer Electronic (Universal Penetrometer)
11	Ductility Testing Machine
12	Ring and ball Apparatus
13	Marshall Mix Design Apparatus
14	Stop watches
15	Vicat apparatus
16	Le-chatler apparatus
17	Bulk density test

TEXT BOOKS	
1.	'Traffic Engineering and Transportation' Planning by Kadiyali L.R,Khanna Publishers, NewDelhi.
2.	'Highway Engineering' by Khanna S.K., Justo C.E.G and Veeraragavan A,Nem Chand Bros,Roorkee. 10th Edition.
REFERENCE BOOKS	
1.	'Transportation Engineering and Planning' by Papacostas C.S. and PD Prevedouros, Prentice Hall of India Pvt. Ltd; NewDelhi.
2.	'Principles of Highway Engineering' by Kadiyali LR, Khanna Publishers, NewDelhi.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

(Common to all branches)

Course Category	Humanities including Management	**Credits**	20HM5T06
Course Type	Theory	**Lecture-Tutorial-Practice**	2 -0 -0
Prerequisites		**Internal Assessment Semester** **End Examination** **Total Marks**	

Course Outcomes		**Blooms Taxonomy Level**
On successful completion of the course, the student will be able to		
CO 1	Understand the concept of Traditional knowledge and its importance	K2
CO 2	Know the need and importance of protecting traditional knowledge	K2
CO 3	Know the various enactments related to the protection of traditional knowledge	K2
CO 4	Understand the concepts of Intellectual property to protect the traditional knowledge	K2
CO 5	Understand the importance of Traditional Knowledge in the development of different sectors	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program												
Outcomes: 1 – Low, 2 - Medium, 3 – High												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	2	0	0	3	0	1	0	2	0	0
CO2	0	0	2	0	0	2	0	2	1	0	0	2
CO3	0	0	1	0	0	3	2	3	1	2	0	1
CO4	0	0	0	0	0	2	1	3	1	1	0	1
CO5	1	0	1	0	0	3	1	1	1	3	0	1

COURSE CONTENT :

Unit I

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

Unit II

Protection of Traditional Knowledge: The need for protecting traditional knowledge -Significance of Traditional knowledge Protection-Role of government to harness Traditional Knowledge

Unit III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.Geographical indications act 2003.

Unit IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Unit V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Reference Books :

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya
4. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
5. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
6. Pramod Chandra, India Arts, Howard Univ. Press, 1983.
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.

Web Resources:

1. https://www.wipo.int/wipo_magazine/en/2017/01/article_0004.html
2. http://iks.iitgn.ac.in/wp-content/uploads/2016/01/Indian-Knowledge-Systems-Kapil-Kapoor.pdf
3. https://www.wipo.int/edocs/mdocs/tk/en/wipo_grtkf_ic_21/wipo_grtkf_ic_21_ref_facilitators_text.pdf

DESIGN & DRAWING OF STEEL STRUCTURES

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE6T17
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Strength of Materials, Structural Analysis.	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSEOBJECTIVES	
1	To introduce the students to limit state design of structural steel members subjected to compressive, tensile and bending loads, including connections.
2	To provide the students the tools necessary for designing structural systems such as roof trusses and gantry girders as per provisions of current code (IS 800 - 2007) of practice.

COURSEOUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Recognize the design philosophy of steel structures and identify the different failure modes of bolted and welded connections, and determine their design strengths.	K3
CO2	Apply the principles, procedures and current code requirements to the analysis and design of steel tension members, columns, column bases and beams	K4
CO3	Select the most suitable section shape and size for tension and compression members and beams according to specific design criteria.	K4
CO4	Identify and compute the design loads on Industrial structures.	K4
CO5	Find out ultimate load of steel beams and portal frames using plastic analysis.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of program															
Outcomes(1-Low,2- Medium,3-High)															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	--	-	-	--	--	--	2	-	2	3	2	-
CO2	2	2	3	--	2	-	--	--	--	--	2	2	2	2	-
CO3	2	2	3	--	2	-	--	--	--	--	2	2	2	2	-
CO4	3	2	3	--	2	2	--	2	2	2	2	3	2	2	3
CO5	2	3	3	2	-	-	1	--	--	--	-	3	2	2	3

COURSE CONTENT	
UNIT-I	**INTRODUCTION TO STRUCTURAL STEEL AND DESIGN OF CONNECTIONS:** General -Types of Steel -Properties of structural steel - I.S. rolled sections - Concept of Limit State Design - Design of Simple and eccentric Bolted and welded connections - Types of failure and efficiency of joint.
UNIT-II	**BEAMS:** Design requirements as per IS Code - Design of laterally supported and unsupported beams - Design of built-up beams - Check for Deflection, Shear, Buckling, Bearing, laterally unsupported beams.

UNIT-III	**TENSION AND COMPRESSION MEMBERS:** Behavior and Design of simple and built-up members subjected to tension - tension splice - Behaviour of short and long columns - Euler'scolumn theory-Design of simple and built-up compression members with lacing and battens-Design of column bases - slab base and gusseted base
UNIT-IV	**DESIGN OF ROOF TRUSSES:** Design of roof trusses – loads on trusses – Purlin design using angle and channel sections – truss design.
UNIT-V	**DESIGN OF PLATE GIRDER:** Design consideration – IS Code recommendations Design of plate girder – Welded – Curtailment of flange plates, stiffeners – splicing and connections.

NOTE: All the designs should teach in Limit State Method.

INTERNAL EXAMINATION PATTERN:

The total internal marks (30) are distributed in two components as follows:

1. Descriptive (subjective type) examination: 20marks.
2. Plates (Drawing sheets): 5marks
3. Assignment: 5marks

FINAL EXAMINATION PATTERN:

The end examination paper should consist of Part A and Part B. part A consist of two questions in Designand Detailing, out of which one question is to be answered. Part B should consist of five questions out of which three questions to be answered. Weightage for Part – A is 40% and Part- B is 60%.

IS Codes:

1. IS-800-2007(Permitted to use in examination hall)
2. IS-875part(I, II,III,IV)
3. Steel tables(Permitted to use in examination hall)

TEXTBOOKS	
1.	"Design of steel structures" as per Limit State Method of Design by S.S.Bavakati, International Publishing House Pvt.Ltd. 5th Edition 2017
2.	"Limit state Design of steel structures" by S. K. Duggal, Tata Mcgraw Hill, and New Delhi. 3rd Edition 2017
WEBREFERENCES	
1.	http://freevideolectures.com/Course/2686/Design-of-Reinforced-Concrete-Structures

WATER RESOURCE ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE6T18
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Hydraulics and Hydraulic Machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To introduce hydrologic cycle and its relevance to civil engineering.
2	Make the students understand physical processes in hydrology and, components of the hydrologic cycle.
3	Appreciate concepts and theory of physical processes and interactions.
4	Learn measurement and estimation of the components hydrologic cycle.
5	Provide an overview and understanding of Unit Hydrograph theory and its analysis.
6	Understand flood frequency analysis, design flood, flood routing.
7	Appreciate the concepts of groundwater movement and well hydraulics
8	Learn overview of flood routing and its effects.
9	Has to be understood and identify the flood occurring areas nearby.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain the theories and principles governing the hydrologic processes and list out the forms of precipitation in real conditions.	K1
CO2	Apply key concepts to several practical areas of engineering hydrology and related design aspects.	K2
CO3	Design major hydrologic components for a need-based structures.	K4
CO4	Estimate flood magnitude and carry out flood routing.	K5
CO5	Demonstrate the recuperation test process in open wells.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO2	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO3	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO4	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO5	3	2	2	2	1	2	--	--	--	--	1	--	1	--	2

COURSE CONTENT	
UNIT I	INTRODUCTION: Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data. Precipitation: Types and forms, measurement, rain gauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data, Frequency of point rainfall, Rain fall data in India. Intensity-Duration-Frequency (IDF) curves, Depth-Area Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm, problems on average rainfall on towns
UNIT II	ABSTRACTIONS FROM PRECIPITATION: Introduction, Initial abstractions. EVAPORATION: Factors affecting, measurement, reduction, Analytical methods of Evaporation estimation. EVAPOTRANSPIRATION: Factors affecting, measurement, control, Potential Evapotranspiration over India. INFILTRATION: Factors affecting, Infiltration capacity curve, measurement, Infiltration Indices. Problems on φ-Index and W-Index.
UNIT III	RUNOFF: Catchment characteristics, Factors affecting runoff, components, computation-empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve. HYDROGRAPH ANALYSIS: Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, synthetic unit hydrograph. Problems on unit hydrograph.
UNIT IV	FLOODS: Causes and effects, frequency analysis - Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management, Design flood, Design storm. FLOOD ROUTING: Hydrologic storage routing, channel and reservoir routing- Muskingum and Puls methods of routing, flood control in India. ADVANCED TOPICS IN HYDROLOGY: Rainfall-Runoff Modelling, Instantaneous Unit Hydrograph (IUH) - Conceptual models - Clark and Nash models, general hydrological models- Chow - Kulandaiswamy model.
UNIT V	GROUNDWATER: Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, specific capacity, permeability, transitivity and storage coefficient, types of wells, well loss, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of a open well-recuperation test.

TEXT BOOKS	
1.	„Engineering Hydrology" by Subramanya, K, Tata McGraw-Hill Education Pvt. Ltd, (2013), NewDelhi.
2.	„Engineering Hydrology" by Jayarami Reddy, P, Laxmi Publications Pvt. Ltd., (2013), New Delhi.
3.	"Irrigation and Water Power Engineering" by Punmia B C, P.B.B Lal, A.K. Jainand A.K. Jain (2009), Laxmi Publications Pvt. Ltd., New Delhi.

REFERENCE BOOKS	
1.	'Water Resources Engineering', Mays L.W, Wiley India Pvt. Ltd, (2013).
2.	'Hydrology' by Raghunath. H.M., New Age International Publishers,(2010).
3.	'Engineering Hydrology –Principles and Practice' by Ponce V.M., Prentice Hall International,(1994).
4.	'Hydrology and Water Resources Engineering' by Patra K.C., Narosa Publications,(2011).
5.	'Applied hydrology' by Chow V.T., D.R Maidment and L.W. Mays, Tata McGraw Hill Education Pvt.Ltd., Transportation Engineering-Id., (2011), NewDelhi.
6.	'Engineering Hydrology' by Ojha C.S.P, R. Berndtsson and P. Bhunya, Oxford University Press,(2010).
WEB REFERENCES	
1.	https://www.digimat.in/nptel/courses/video/105104103/L01.html

ENVIRONMENTAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core Courses	**Course Code**	20CE6T19
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	----	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	Outline planning and the design of water supply systems for a community/town/city.
2	Impart understanding of importance of protection of water source quality and enlightens the efforts involved in converting raw water into clean potable
3	Outline planning and the design of wastewater collection, conveyance and treatment systems for a community/town/city.
4	Impart understanding of treatment of sewage and the need for its treatment.
5	Teach planning, and design of septic tank and imhoff tank and the disposal of the effluent from these low cost treatment systems and effluent disposal method

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Classify sources of water and their characteristics	K4
CO2	Identify various water treatment methods and know about their functions	K2
CO3	Examine the effects and primary treatment of sewage	K4
CO4	Know the different types of sewerage systems and storm drains	K2
CO5	Analyse the available disposal options and their practical implications	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	2	3	-	-	1	3	-	3	3	-	-	3	2
CO2	3	-	3	2	2	2	-	3	-	3	-	-	3	3	2
CO3	3	-	3	2	-	2	-	-	-	3	-	-	3	2	2
CO4	2	-	3	2	3	-	-	-	-	3	2	3	3	2	2
CO5	2	2	3	2	2	-	-	3	3	3	2	3	3	3	2

COURSE CONTENT	
UNIT I	**Introduction**: Importance and Necessity of Protected Water Supply systems, Water borne diseases, Flow chart of public water supply system, Role of Environmental Engineer. **Water Demand and Quantity Estimation:** Estimation of water demand for a town or city, Per capita Demand and factors influencing it-Types of water demands and its variations-factors affecting water demand, Design Period, Factors affecting the Design period, Population forecasting.
UNIT II	**Quality of Water:** Characteristics of water– Physical, Chemical and Biological.Comparison of sources with reference to quality- IS 10500 2012 and WHO guidelines for drinking water - Water quality standards for Agriculture, Industries and Construction **Analysis of Water:**Analysis of Water – Physical, Chemical and Biological characteristics-Biological Examination-Measurement of BOD and COD -BOD equations.
UNIT III	**Treatment of Water:** Treatment methods: Theory and Design of Sedimentation, Coagulation, Sedimentation with Coagulation, Filtration **Disinfection:** Theory of disinfection-Chlorination and other Disinfection methods, Softening of Water, Removal of color and odors- Removal of Iron and Manganese - Adsorption-Fluoridation and deflouridation– Aeration–Reverse Osmosis- Ion exchange– Ultrafiltration **Treatment of sewage:** Primary treatment-Screens-grit chambers-grease traps–floatation–sedimentation – design of preliminary and primary treatment units-Aerobic and anaerobic treatment process-comparison.
UNIT IV	**Introduction to Sanitation** – Systems of sanitation – relative merits & demerits – collection and conveyance of wastewater – sewerage – classification of sewerage systems- Estimation of sewage flow and storm water drainage – fluctuations– types of sewers - Hydraulics of sewers and storm drains– design of sewers. **Suspended growth process:** Activated Sludge Process, principles, designs, and operational problems, modifications of Activated Sludge Processes, Oxidation ponds, Aerated Lagoons. **Attached Growth Process:** Trickling Filters–mechanism & design,RBCs, Fluidized bed reactors
UNIT V	**Miscellaneous Treatment Methods:** Nitrification and Denitrification – Removal of Phosphates –UASB–Membrane reactors-Integrated fixed film reactors. Anaerobic Processes: Septic Tanks and Imhoff tanks- working Principles and Design–disposal of septic tank effluent. **Disposal of sewage:** methods of disposal – disposal into water bodies-Oxygen Sag Curve-disposal on land- sewage sickness

TEXT BOOKS	
1.	Wastewater Engineering Treatment and Reuse by Metcalf & Eddy, Tata McGraw-Hill 4th Edition 2017.
2.	Elements of Environmental Engineering by K.N. Duggal, S. Chand & Company Ltd. New Delhi, 3rd Edition 1996
3.	Environmental Engineering by Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985.

REFERENCE BOOKS	
1.	Water Supply Engineering – Dr. P.N. Modi
2.	Water Supply Engineering – B.C. Punmia
WEB RESOURCES	
1.	https://nptel.ac.in/courses/103107084

FUNDAMENTALS OF ELECTRIC VEHICLES

(Open Elective – II offered to other departments)

Course Category	Professional Core Courses	**Course Code**	20EE6T19
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	**NIL**	**Internal Assessment**	**30**
		Semester End Examination	**70**
		Total Marks	**100**

COURSE OBJECTIVES	
1	To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
2	To understand various power converters used in electric vehicles.
3	To know various architecture of hybrid electric vehicles.
4	To be familiar all the different types of motors suitable for electric vehicles.
5	To have knowledge on latest developments in strategies and other storage systems.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate different types of electric vehicles..	K3
CO2	Select suitable power converters for EV applications.	K2
CO3	Design HEV configuration for a specific application.	K4
CO4	Choose an effective method for EV and HEV applications.	K3
CO5	Analyze a battery management system for EV and HEV	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	-	-	2	2	-	-	-	-	2	1	1
CO2	2	3	-	-	-	1	1	-	-	-	-	-	2	2
CO3	-	3	-	-	-	1	-	-	-	-	2	2	1	2
CO4	3	2	-	-	-	2	1	-	-	-	2	-	1	2
CO5	2	-	-	-	-	2	-	-	-	-	-	2	2	2

COURSE CONTENT	
UNIT 1	**Introduction** Fundamentals of vehicles - Components of conventional vehicles - drawbacks of conventional vehicles – Need for electric vehicles - History of Electric Vehicles – Types of Electric Vehicles – Advantages and applications of Electric Vehicles.
UNIT 2	**Components of Electric Vehicles** Main components of Electric Vehicles – Power Converters - Controller and Electric Traction Motor – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.
UNIT 3	**Hybrid Electric Vehicles** Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs - Series and Parallel HEVs – Complex

	HEVs – Range extended HEVs – Examples - Merits and Demerits.
UNIT 4	**Motors for Electric Vehicles** Characteristics of traction drive - requirements of electric machines for EVs – Different motors suitable for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only)
UNIT 5	**Energy Sources for Electric Vehicles** Batteries - Types of Batteries – Lithium-ion - Nickel-metal hydride - Lead-acid – Comparison of Batteries - Battery Management System – Ultra capacitors – Flywheels – Fuel Cell – it's working.

TEXT BOOKS	
1	Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.
2	Denton - Tom. Electric and hybrid vehicles. Rutledge - 2020.
REFERENCE BOOKS	
1	Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.
2	Chau - Kwok Tong. Electric vehicle machines and drives: design - Analysis and Application. John Wiley & Sons - 2015.
3	Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge university press - 2015
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/108106170
2	https://inverted.in/blog/fundamentals-of-electric-vehicles

INTRODUCTION TO AUTOMOBILE ENGINEERING
(Open Elective – II offered to other departments)

Course Category	Open Elective	**Course Code**	20ME6T25
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To learn functions of different components in Automobiles
2	To impart knowledge on Transmission systems and Steering Systems.
3	To impart the knowledge on ignition system & suspension systems.
4	To impart the knowledge of Braking system and Engine specification.
5	To understand the concept of safety and Engine emission control systems

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the function of various components of automobile.	K2
CO2	Identify the merits and demerits of the various transmission and steering systems.	K2
CO3	Describe the concept of Ignition and Suspension systems.	K2
CO4	Explain the features of Braking system and Engine specification.	K3
CO5	Analyze the Engine emission control standards.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	2	-	-	-	-	-	2	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	1	-	2	2	-	-	-	-	-	2	1
CO5	2	2	1	-	-	-	2	-	-	-	-	1	3	-

COURSE CONTENT

UNIT I

INTRODUCTION: Components of four-wheeler automobile-chassis and body-power unit-types of automobile engines, engine construction, oil filters, oil pumps, air filters, Fuel pump, nozzle, Types of carburetors.

UNIT II

TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, Propeller shaft-Hotch-Kiss drive, Torque tube drive, universal joint, differential rear axles-types-wheels and tires.

STEERING SYSTEM: Steering geometry-camber, castor, king pin rake, combined angle toe-in, center point steering. steering gears – types, steering linkages.

UNIT III

IGNITION SYSTEM: Function of an ignition system, auto transformer, electronic ignition using contact triggers-spark advance and retard mechanism.

SUSPENSION SYSTEM: Objects of suspension systems-rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT IV

BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, pneumatic and vacuum brakes.

ENGINE SPECIFICATION: Introduction-engine specifications with regard to power, speed, torque, no. of cylinders and arrangement.

UNIT V

SAFETY SYSTEMS: Introduction, safety systems - seat belt, air bags, bumper, wind shield, suspension sensors, traction control, mirrors.

ENGINE EMISSION CONTROL: Introduction-types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification.

TEXT BOOKS

1. Automotive Mechanics / Heitner.
2. Automobile Engineering / William Crouse, TMH Distributors.
3. Automobile Engineering- P.S Gill, S.K. Kataria& Sons, New Delhi.

REFERENCE BOOKS

1. Automotive Engines Theory and Servicing, James D. Halderman and Chase D. Mitchell Jr., Pearson education inc.
2. Automotive Engineering / Newton Steeds & Garrett.
3. Automotive Mechanics – Vol. 1 & Vol. 2 / Kripal Singh, standard publishers.

WEB RESOURCES

1. https://nptel.ac.in/courses/107/106/107106080/
2. http://gabook.cyou/file/nptel-automobile-engineering
3. https://nptel.ac.in/courses/107/106/107106088/

SENSORS AND TRANSDUCERS
(Open Elective – II offered to other departments)

Course Category	Open Elective	**Course Code**	20EC6T26
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	control systems	**Internal Assessment** **Semester End Examination** **Total Marks**	25 75 100

COURSE OBJECTIVES: By studying this course the student will learn	
1	The principle of various Transducers and their construction
2	The transducer construction, classification, principle of operation and characteristics
3	About transducers for measurement of physical parameters
4	Temperature measurement using transducers
5	Applications and principles of operation, standards and units of measurements

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Discuss role of transducers and Sensor in instrumentation	K1
CO2	Descriptive view for the transducer construction, classification, principle of operation and characteristics.	K2
CO3	Gain knowledge about transducers for measurement of displacement, strain, velocity, analyze transducers for measurement of pressure , force and flow	K3
CO4	Analyze transducers for measurement of Temperature	K4
CO5	Analyze sensors used in industrial applications	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	2	-	1	-	-	-	-	-	-	-
CO2	1	2	2	-	1	-	-	-	-	-	-	-
CO3	2	2	2	-	2	-	-	-	-	-	-	-
CO4	2	3	2	-	2	-	-	-	-	-	-	-
CO5	3	3	3	-	2	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**Introduction:** Functional elements of an instrument, generalized performance characteristics of instruments – static characteristics, dynamic characteristics. Zero order, first order, second order instruments – step response, ramp response and impulse response. Response of general form of instruments to periodic input and to transient input

UNIT II	**Transducers for motion and dimensional measurements:** Relative displacement, translation and rotational resistive potentiometers, resistance strain gauges, LVDT, synchros, capacitance transducers, Piezo-electric transducers, electro-optical devices, nozzle – flapper transducers, digital displacement transducers, ultrasonic transducers, Gyroscopic sensors
UNIT III	**Transducers For Force Measurement**: Bonded strain gauge transducers, Photo-electric transducers, variable reluctance pickup, torque measurement dynamometers. **Transducers For Flow Measurement:** Hot wire and hot-film anemometers, Electro-magnetic flow meters, laser Doppler velocity meter **Transducers For Pressure Measurement:** Manometers, elastic transducers, liquid systems, gas systems, very high pressure transducers.
UNIT IV	**Transducers For Temperature Measurement:** Thermal expansion methods, Thermometers (liquid in glass), pressure thermometers, Thermocouples, Materials configuration and techniques. Resistance thermometers, Thermistors, junction semiconductors, Sensors, Radiation methods, Optical pyrometers, Dynamic response of temperature sensors heat flux Sensors, Transducers for liquid level measurement, humidity, silicon and quartz sensors, fiber optic sensors.
UNIT V	**Smart sensors:** Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors — Sensors for Manufacturing –Sensors for Environmental Monitoring

TEXT BOOKS	
1.	Sensors and Transducers, D. Paranaiba ,PHI Learning Private Limited.
2.	Mechatronics,W. Bolton ,Pearson Education Limited.
REFERENCE BOOKS	
1.	Transducers and Instrumentation, by D.V.S. Murthy (PHI)
2.	Instrumentation Measurement & Analysis, by B.C. Nakra, K.K. Choudry, (TMH)
WEB RESOURCES	
1.	https://youtu.be/hv-aBonZMRQ
2.	https://www.youtube.com/watch?v=qSa3GNjIyy0

COMPUTER FORENSICS

(Open Elective – II offered to other departments)

Course Category	Professional Core	**Course Code**	20CS7T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Identify Security Risks And Take Preventive Steps
2	Understand the Forensics Fundamentals
3	Understand the Evidence Capturing Process

COURSE OUTCOMES		**BTL**
Upon successful completion of the course, the student will be able to:		
CO1	Understand the Cybercrime Fundamentals	K2
CO2	List the types of attacks on networks	K4
CO3	Analyze various tools available for Cybercrime Investigation	K4
CO4	Summarize the Computer Forensics and Investigation Fundamentals and tools	K2
CO5	Analyze the legal perspectives of Cybercrime	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	1	0	2	0	0	0	0	2	2	2
CO2	3	2	2	2	2	1	0	2	0	0	0	0	2	2	2
CO3	3	2	2	2	2	1	0	2	0	0	0	0	2	2	2
CO4	3	2	2	2	2	1	0	2	0	0	0	0	2	2	2
CO5	3	2	2	2	2	1	0	2	0	0	0	0	2	2	2

COURSE CONTENT	
UNIT I	**Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.
UNIT II	**Tools and Methods :** Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.
UNIT III	**Cyber Crime Investigation:** Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-

	Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.
UNIT IV	**Computer Forensics and Investigations:** Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.
UNIT V	**Cyber Crime Legal Perspectives:** Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act-ITA2000, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime andPunishment, Cyberlaw, Technology and Students: Indian Scenario.

TEXT BOOKS	
1.	Sunit Belapure Nina Godbole "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY,First Edition 2011.
2.	Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
REFERENCE BOOKS	
1.	Michael T. Simpson, Kent Backman and James E. Corley, "Hands on Ethical Hacking and Network Defence", Cengage, 2019.
2.	Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi,First Edition,2015
3.	Alfred Basta, Nadine Basta,Mary Brown and Ravinder Kumar "Cyber Security and Cyber Laws" , Cengage,First Edition,2018.
WEB RESOURCES	
1.	CERT-In Guidelines- http://www.cert-in.org.in/
2.	https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks [Online Course]
3.	https://computersecurity.stanford.edu/free-online-videos [Free Online Videos]
4.	Nickolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu License: Creative Commons BY-NC-SA.

INDUSTRIAL STRUCTURES
DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE6T20
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	Design and drawing of steel structures, Design and drawing of reinforced concrete structures.	**Internal AssessmentSemester** **End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To make the student understand how to design the stable industrial structures
2	To understand how to design the elements in rcc and steel structures
3	To make the student understand how to design the stable foundation for industrial structures.
4	To understand how to design like Transmission Line Towers &Substation Structures
5	Esure in codal and safety provisions for Pipe supporting structures

COURSE OUTCOMES		**Cognitive**
Upon successful completion of the course, the student will be able to:		**Level**
CO1	Prepare the layout for industrial buildings	K3
CO2	Design for functional requirements	K4
CO3	Design steel girder, bunker and silos	K4
CO4	Design Transmission Line Towers.	K4
CO5	Design RC structures like chimneys, silos and folded plates	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	-	2	-	3	3	2	1	2	1	2	1	2	3
CO2	1	2	1	2	-	2	1	2	1	2	1	2	3	2	2
CO3	1	2	-	2	-	1	2	2	1	2	1	2	1	2	1
CO4	1	2	-	2	-	2	1	2	1	2	1	2	2	2	2
CO5	1	2	-	2	-	1	1	2	1	2	1	2	1	2	2

COURSE CONTENT	
UNIT I	**Planning and Functional Requirements** Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety – Protection against noise and vibration - Guidelines of Factories Act.
UNIT II	**Industrial Buildings** Roofs for Industrial Buildings - Steel and RCC - Gantry Girders - Design of Corbels and Nibs– Machine foundations.
UNIT III	**Power Plant Structures** Types of power plants – Design of Turbo generator foundation – containment structures.
UNIT IV	**Power Transmission Structures** Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers.
UNIT V	**Auxiliary Structures** Chimneys and Cooling Towers – Bunkers and Silos – Pipe supporting structures.

TEXT BOOKS	
1.	Manohar S.N, "Tall Chimneys - Design and Construction", Tata McGraw Hill, 1985
2.	Santha kumar A.R. and Murthy S.S., "Transmission Line Structures", Tata McGraw Hill, 1992.
3.	Srinivasulu P and Vaidyanathan.C, "Handbook of Machine Foundations", Tata McGraw Hill, 1976.
REFERENCE BOOKS	
1.	Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", Birkhauser Publishers, 2004.
2.	Proceedings of Advanced course on "Industrial Structures", Structural Engineering Research Centre, Chennai, 1982.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105106113
2.	https://nptel.ac.in/courses/105105162

FOUNDATION ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE6T21
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	Geotechnical Engineering	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To impart the principles of important field tests such as SPT and Plate bearing test.
2	To learn about stability of the slopes in different conditions.
3	To determine the magnitude and line of action of lateral earth pressure.
4	To impart the student knowledge of types of shallow foundations, determination of their bearing capacity, immediate and consolidation settlements of shallow foundations.
5	To enable the student to imbibe the concepts of pile foundations and determine their load carrying capacity.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Use the field test data and arrive at the bearing capacity.	K3
CO2	Selecting an appropriate slope stability analysis method for a given slope.	K3
CO3	Design different types of retaining walls.	K4
CO4	Understand the various types of shallow foundations and decide on their location based on soilcharacteristics. Also compute the magnitude of foundation settlement to decide the size of foundation accordingly	K3
CO5	Apply the principles of bearing capacity of piles and design them accordingly.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1	1	1	1	1	1	2	3	2	3	3
CO2	3	3	3	3	1	1	1	2	1	1	2	3	2	3	3
CO3	2	3	3	3	1	1	1	2	1	1	2	3	2	3	2
CO4	2	3	3	3	1	1	1	2	1	1	1	3	2	3	2
CO5	3	3	3	3	1	1	1	1	1	1	2	3	2	3	3

COURSE CONTENT	
UNIT I	**SITE INVESTIGATION AND SELECTION OF FOUNDATION:** Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed samples – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT, CPT) – Data interpretation - Selection of foundation based on soil condition- Bore log report.
UNIT II	**STABILITY OF SLOPES:** Infinite and finite earth slopes in sand and clay – types of failures – factor of safety of infinite slopes – stability analysis by Swedish arc method, standard method of slices – Taylor's Stability Number, Stability of slopes of dams and embankments
UNIT III	**EARTH RETAINING STRUCTURES:** Rankine's & Coulomb's theory of earth pressure – Culmann's graphical method - earth pressures in layered soils, Earth pressure at rest, Jaky's formula, Design of cantilever retaining wall, Sliding, Overturning, and bearing capacity modes of failure.
UNIT IV	**SHALLOW FOUNDATIONS – BEARING CAPACITY AND SETTLEMENT CRITERIA:** Types of foundations and factors to be considered in their location - Bearing capacity – criteria for determination of bearing capacity - Factors influencing bearing capacity – Analytical methods to determine bearing capacity – Terzaghi's theory, IS Method. Safe bearing pressure based on N- value – allowable bearing pressure; safe bearing capacity and settlement from plate load test – Types of foundation settlements and their determination - allowable settlements of structures,
UNIT V	**DEEP FOUNDATIONS :** Pile foundation-types of pile foundations, methods of installation, codal practices for permissible load under vertical and lateral loads, stresses during pile driving, Analysis of utlimate and safe load carrying capacity of piles, pile groups, negative skin friction, under-reamed piles, Pile load test, equipment used for construction of foundation systems, Analysis of utlimate and safe load carrying capacity of piles.

TEXT BOOKS	
1.	B.M Das, "Principles of Foundation Engineering", 4th Edition, Indian edition
2.	Bowles, J.E., "Foundation Analysis and Design", 5th Edition, McGraw- Hill International, 2000
REFERENCE BOOKS	
1.	Swami Saran, "Analysis and Design of Substructures", 2nd Edition, Oxford & IBH Publishing Company Pvt. Ltd., 2009

2.	Gopal Ranjan & ASR Rao, "Basic and Applied Soil Mechanics", 3rd Edition, New Age International Pvt. Ltd, Publishers, 2002.
WEB RESOURCES	
1.	https://archive.nptel.ac.in/courses/105105185/
2.	https://archive.nptel.ac.in/courses/105105176/
3.	https://archive.nptel.ac.in/courses/105105168/

IS Codes: IS 6403-Code of practice for determination of bearing capacity of shallow foundations.

IS 1888- Methods of load test on soils.

IS 2911-Parts I,II,III,IV. For pile foundation.

URBAN HYDROLOGY STORM DRAINAGE & MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE6T22
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	Appreciate the impact of urbanization on catchment hydrology and understand the importance of short duration rainfall runoff data for urban hydrology studies.
2	Learn the techniques for peak flow estimation for storm water drainage system design.
3	Understand the concepts in design of various components of urban drainage systems.
4	Learn some of the best management practices in urban drainage.
5	Understand the concepts of preparation master urban drainage system.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Develop intensity duration frequency curves for urban drainage systems.	K3
CO2	Identify the techniques to estimate peak flow of storm water and design of drainage system.	K3
CO3	Develop design storms to size the various components of drainage system.	K3
CO4	Formulate for best management practices in urban drainage system.	K2
CO5	Prepare master plan of drainage system for urbanized area.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	1	-	-	-	-	1	-	1	-	2
CO2	3	3	3	2	2	1	-	-	-	-	1	-	1	-	2
CO3	3	3	3	2	2	1	-	-	-	-	1	-	1	-	2
CO4	3	3	3	2	2	1	-	-	-	-	1	-	1	-	2
CO5	3	3	3	2	2	1	-	-	-	-	1	-	1	-	2

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Urbanization and its effect on water cycle – Urban Hydrologic cycle – trends in urbanization – Effect of urbanization on hydrology. **PRECIPITATION ANALYSIS:** Importance of Short Duration of Rainfall and Runoff data, Methods of Estimation of time of concentration for design of Urban Drainage Systems, Intensity-Duration - Frequency (IDF) Curves, Design Storms for Urban Drainage Systems
UNIT II	**APPROACHES TO URBAN DRAINAGE:** Time of concentration, Peak Flow Estimation Approaches, Rational Method, NRCS Curve Number Approach, Runoff Quantity and Quality, waste water and Storm Water Reuse, Major and Minor Systems.
UNIT III	**ELEMENTS OF DRAINAGE SYSTEMS:** Open Channel, Underground Drains, Appurtenances, Pumping, and Source Control.
UNIT IV	**ANALYSIS AND MANAGEMENT:** Storm water drainage structures, design of storm waternetwork- Best Management Practices–detention and retention facilities, Swales, constructed wetlands, models available for storm water management.
UNIT V	**MASTER DRAINAGE PLANS:** Issues to be concentrated upon – Typical urban drainage master plan, interrelation between water resources investigation and urban planning processes, planning objectives, comprehensive planning, and use of models in planning.

TEXT BOOKS	
1.	"Manual on Drainage in Urbanized area" by Geiger W. F., J Marsalek, W. J. Rawls and F. C. Zuidema, (1987 - 2 volumes),UNESCO.
2.	"Urban Hydrology" by Hall M J (1984), Elsevier Applied Science Publisher.
3.	"Storm water Detention for Drainage" by Stahre P and Urbonas B (1990), Water Quality and CSO Management, Prentice Hall.
REFERENCE BOOKS	
1.	"Urban water cycle processes and interactions" by Marsalek et. Al., (2006), Publication No. 78, UNESCO, Paris.
2.	Urban Hydrology, Hydraulics and Storm water Quality: Engineering Applications and Computer Modelling" by Akan A.O and R.L. Houghtalen (2006), Wiley International.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/105105048/M7L7.pdf
2.	http://www.iitg.ac.in/kartha/CE551/Lectures/Lecture16.pdf
3.	http://nptel.ac.in/courses/105105048/8

INDUSTRIAL WASTE MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE6T23
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	-------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To make the students understand about industrial waste, its characteristics and effects
2	To make students to know various sources of industrial waste and how to recycle and reuse them.
3	To understand what are the various treatment technologies for treating industrial waste
4	To create wariness of hazardous waste and their treatment

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Define the characteristics of industrial waste and environmental regulation for prevention and control of industrial and hazardous waste	K1
CO2	Explain waste management approach and interpret the applications of recycle, reuse and by product recovery.	K2
CO3	Classify various sources of waste and its characteristics	K2
CO4	Interpreting various treatment technologies and its applications	K3
CO5	Defining hazardous waste and their treatment technologies.	K1
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of program															
Outcomes (1 - Low, 2- Medium, 3-High)															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	2	2	3	1	2	2	3	2	2	1
CO2	3	3	2	2	2	2	2	3	1	2	2	3	2	1	2
CO3	2	3	3	2	3	1	2	3	1	3	2	3	3	3	3
CO4	3	2	3	3	3	1	1	3	1	2	3	3	3	3	2
CO5	3	3	2	2	3	1	1	3	1	2	2	3	2	2	3

COURSE CONTENT	
UNIT I	**INTRODUCTION** Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Environmental legislation related to prevention and control of industrial effluents and hazardous wastes

UNIT II	**CLEANER PRODUCTION** Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.
UNIT III	**POLLUTION FROM MAJOR INDUSTRIES** Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Waste water reclamation concepts
UNIT IV	**TREATMENT TECHNOLOGIES** Equalization – Neutralization – Removal of suspended and dissolved organic solids - Chemical oxidation – Adsorption - Removal of dissolved inorganic – Combined treatment of industrial and municipal wastes – Residue management – Dewatering – Disposal
UNIT V	**HAZARDOUS WASTE MANAGEMENT** Hazardous wastes - Physio chemical treatment – solidification – incineration – Secure land fills

TEXT BOOKS	
1.	Rao M. N. & Dutta A. K. , "Waste water Treatment", Oxford - IBH Publication, 3rd Edition 1995
2.	Eckenfelder W.W. Jr., "Industrial Water Pollution Control", McGraw Hill Book Company, New Delhi,3rd Edition 1999
3.	Stephenson R.L. and Blackburn J.B., Jr., "Industrial Waste water Systems Hand book", Lewis Publisher, New York, 1998
REFERENCE BOOKS	
1.	Freeman H.M., "Industrial Pollution Prevention Hand Book", McGraw Hill Inc., New Delhi, 1995.
2.	Bishop, P.L., "Pollution Prevention: Fundamental & Practice", McGraw Hill, 2000.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105105160

RAILWAYS, AIRPORTS & SEAPORTS

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional course	**Course Code**	20CE6T24
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Highway Engineering	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To know various components and their functions in a railway track.
2	To acquire design principles of geometrics in a railway track.
3	To know various techniques for the effective movement of trains.
4	To acquire design principles of airport geometrics and pavements.
5	To know the planning, construction and maintenance of Docks and Harbours.
6	To know about the fundamental of airways.
7	To know about the different fundamental components of harbours and docks.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain the various concepts in railway design and components of railway track.	K2
CO2	Analyze the construction process, maintenance and operation of railway track.	K4
CO3	List out the various components of airports, planning concepts and air traffic controls.	K2
CO4	Evaluate the design of airport, cost estimation and geometric design of airports.	K5
CO5	List out the various terms in harbour engineering and its classification.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	1	3	-	2	1	3	3	-	-	1	-	2	1
CO2	3	-	-	-	3	-	1	-	3	2	-	-	2	-	2
CO3	2	-	1	-	3	-	-	3	-	-	-	-	-	3	-
CO4	-	2	-	2	-	1	-	-	3	-	1	1	2	-	-
CO5	1	-	2	3	-	-	1	-	3	-	1	1	-	-	2

COURSE CONTENT	
UNIT I	**COMPONENTS OF RAILWAY ENGINEERING:** Permanent way components – Railway Track Gauge - Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast – Rail Fastenings – Creep of Rails- Theories related to creep – Adzing of Sleepers- Sleeper density – Rail joints. **GEOMETRIC DESIGN OF RAILWAY TRACK:** Alignment – Engineering Surveys - Gradients- Grade Compensation- Cant and Negative Super elevation- Cant Deficiency – Degree of Curve – safe speed on curves – Transition curve – Compound curves – Reverse curves – Extra clearance on curves – widening of gauge on curves – vertical curves – cheek rails on curves.

UNIT II	**TURNOUTS &CONTROLLERS:** Track layouts – Switches – Design of Tongue Rails – Crossings – Turnouts – Layout of Turnout – Double Turnout – Diamond crossing – Scissors crossing, Signal Objectives – Classification – Fixed signals – Stop signals – Signaling systems – Mechanical signaling system – Electrical signaling system – System for Controlling Train Movement – Interlocking – Modern signaling Installations.
UNIT III	**AIR TRANSPORTATION SYSTEM:** Development of air transportation system with particular reference to India; Aero plane components; Air–craft characteristics. Airport Planning &Design: Airport Master plan – Airport site selection – Air craft characteristics – Zoning laws – Airport classification – Runway orientation – Wind rose diagram – Runway length – Taxiway design – Terminal area and Airport layout – Visual aids and Air traffic control.
UNIT IV	**RUNWAY DESIGN:** Various Design factors – Design methods for Flexible pavements – Design methods for Rigid pavements – LCN system of Pavement Design – Airfield Pavement Failures – Maintenance and Rehabilitation of Airfield pavements– Airport Drainage – Design of surface and subsurface drainage.
UNIT V	**WATER TRANSPORTATION:** Types of water transportation; advantages and disadvantages of water transportation. Planning, Layout, Construction & Maintenance of Docks & Harbours: Classification of ports - Requirement of a good port – classification of Harbours – Docks - Dry & wet docks – Transition sheds and workhouses – Layouts; Quays – construction of Quay walls – Wharves Jetties – Fender systems. Tides - Tidal data and Analysis – Break waters – Dredging – Maintenance of Ports and Harbours – Navigational aids.

TEXT BOOKS	
1.	„Railway Engineering" by Satish Chandra and Agarwal M.M. 2nd Edition 2013.
2.	„Docks and Harbour Engineering" by Bindra S.P. – Dhanpathi Rai & Sons.
REFERENCE BOOKS	
1.	"Railway Engineering" by Saxena &Arora –Dhanpat Rai Publications, NewDelhi.
2.	„Transportation Engineering Planning Design" by Wright P.H. &Ashfort N.J. - John Wiley &Sons.
3	„Airport Engineering" by Virendra Kumar, DhanpatRai Publishers, NewDelhi.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/105107123/

ENVIRONMENTAL ENGINEERING LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core courses lab	Course Code	20CE6L09
Course Type	LAB	L-T-P-C	0-0-3-2
Prerequisites	ENGINEERING CHEMISTRY & ENVIRONMENTAL ENGINEERING	Internal Assessment Semester End Examination Total Marks	15 35 50

COURSE LEARNING OBJECTIVES	
1	Estimation of some important characteristics of water and wastewater in the laboratory.
2	It also gives the significance of the characteristics of the water and wastewater.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Perform the different laboratory techniques for examining the water quality parameters	K2
CO2	Perform the different laboratory techniques for examining the wastewater quality parameters	K2
CO3	Analyze the laboratory data and comment with respect to permissible limits and field conditions.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	2	1	1	--	1	1	1	--	2	2	2
CO2	2	3	3	2	1	1	1	--	1	1	1	--	1	2	2
CO3	2	3	3	2	1	1	1	--	1	1	1	--	1	2	2

LIST OF EXPERIMENTS	
1	Determination of pH and Electrical Conductivity (Salinity) of Water and Soil
2	Determination and estimation of Total Hardness–Calcium & Magnesium.
3	Determination of Alkalinity/Acidity.
4	Determination of Chlorides in water and soil
5	Determination and Estimation of total solids,organic solids and inorganic solids and settleable solids by Imhoff Cone
6	Determination of Iron.
7	Determination of Dissolved Oxygen with D.O. Meter &Wrinklers Method.
8	Determination of N, P, K values in solid waste
9	Physical parameters – Temperature, Colour, Odour, Turbidity, Taste.

10	Determination of Optimum coagulant dose.
11	Determination of Chlorine demand.
12	. Determination of C.O.D and B.O.D.

*Note: At least 10 Experiments has to be completed

SNO.	LIST OF EQUIPMENTS
1	pH meter
2	Turbidity meter
3	Conductivity meter
4	Hot air oven
5	Muffle furnace
6	Dissolved Oxygen meter
7	U–V visible spectrophotometer
8	COD Reflux Apparatus
9	Jar Test Apparatus
10	BOD incubator
11	Autoclave
12	Laminar flow chamber
13	Hazen's Apparatus

TEXT BOOKS	
1	Standard Methods for Analysis of Water and Waste Water – APHA.
2	Chemical Analysis of Water and Soil by KVSG Murali Krishna, ReemPublications, New Delhi

REFERENCE BOOKS	
1	Relevant IS Codes.
2	Chemistry for Environmental Engineering by Sawyer and Mc. Carty
WEB RESOURCES	
1	http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/index.html

ESTIMATION & SPECIFICATIONS LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core courses lab	**Course Code**	20CE6L10
Course Type	LAB	**L-T-P-C**	0-0-3-2
Prerequisites	Building Planning and Drawing, Design and drawing ofReinforced Concrete	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

	COURSE LEARNING OBJECTIVES
1	Understand the quantity calculations of different components of the buildings.
2	Understand the rate analysis of different quantities of the buildings components.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain the basic concept of quantity estimation for building, roads, canals and hydraulic structures by manual	K2
CO2	Develop the specification for the materials used in construction and preparing reports	K4
CO3	Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	1	1	-	1	1	-	1	-	1	1	1
CO2	1	2	-	2	1	2	1	2	-	2	1	-	1	2	2
CO3	1	2	1	-	1	2	1	-	1	2	1	-	1	2	2

	LIST OF EXPERIMENTS
1	Introduction, Types of estimation
2	Approximate estimate of a two bedroom building, school building
3	Detailed estimation of two bed roomed building by using long wall short wall method
4	Detailed estimation of two bed roomed building by using center line method
5	Analysis of rate of different items of works
6	Estimate the quantity of steel of a R.C.C elements like beams, slab etc.,
7	Earth work calculation for roads and canals -Trapezoidal ,Prismoidal , Mid-ordinate & mean sectional area
8	Prepare a contract document for two bed roomed building
9	Detailed estimate of a bitumen road ,cc road, RCC slab culvert
10	Valuation of a building

*Note: At least 10 Experiments has to be completed

	TEXT BOOKS
1	B.N Dutta ‘Estimating and Costing in DEPARTMENT OF CIVIL ENGINEERING’, UBS Publishers & Distributors (P) Ltd,2010
2	B.S. Patil, ‘DEPARTMENT OF CIVIL ENGINEERING Contracts and Estimates’, University Press, 2006

	REFERENCE BOOKS
1	Standard Data book for analysis and rates.
2	Standard Bid Evaluation Form, Procurement of Goods or Works, The World Bank, April 1996

STAAD & CAD LAB

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core courses lab	**Course Code**	20CE5L11
Course Type	LAB	**L-T-P-C**	0-0-3-2
Prerequisites	BUILDING PLANNING & DRAWING	**Internal Assessment** **Semester End Examination** **Total Marks**	15 35 50

COURSE LEARNING OBJECTIVES	
1	To introduce computer aided drafting packages and commands for modelling and sketching.
2	To draw the geometric entities and create 2D and 3D wire frame models.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Use the software packers for drafting and modeling	K3
CO2	Create 2D and 3D models of Engineering Components	K3
CO3	Draw objects using AUTOCAD	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	1	-	-	2	-	-	1	--	3	3	1
CO2	3	3	3	2	1	-	-	2	-	-	1	--	3	3	1
CO3	3	3	3	2	1	-	-	2	-	-	1	--	3	3	1

LIST OF EXPERIMENTS	
1	Introduction to CAD software and its functional keys
2	Generation of points, lines, curves, polygons, dimensioning.
3	Types of modelling:object selection commands –edit, zoom, cross hatching, pattern filling,utility commands
4	2D wire frame modelling.
5	3D wire frame modelling
6	Examples to exercise different options like save restore, delete, joint, single option.
7	**Computer Aided Solid Modelling:** Isometric projections.

8	**Computer Aided Solid Modelling:** Orthographic projections.
9	Modelling of simple solids.

S.NO.	LIST OF EQUIPMENTS
1	**Equipment needed: Computers and Software: AutoCAD 2017**

TEXT BOOKS	
1	Mastering Auto CAD 2017 and Auto CAD LT 2017 – George Omura, Sybex
REFERENCE BOOKS	
1	Auto CAD 2017 fundamentals- Elisemoss, SDCPub
2	Engineering Drawing + AutoCAD – K. Venugopal, V. Prabhu Raja, NewAge.

SOFT SKILLS AND INTERPERSONAL COMMUNICATION

Course Category	Humanities	**Course Code**	20HE6S01
Course Type	Skill Oriented Course	**L-T-P-C**	1 – 0 – 2 – 2
Prerequisites	Life skills for better life	**InternalAssessment** **External Assessment (Viva-Voce)** **Total Marks**	15 35 50

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Understand the significance of soft skills and its importance towards his goal setting.
CO2	Develop interpersonal relations through effective communication and public speaking.
CO3	Build confidence exercising verbal and non-verbal techniques with analytical skills for his success
CO4	Utilize various skills required to become a good leader and thorough professional.
CO5	Improve decision-making skills and problem-solving skills with emotional intelligence.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-
CO5	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-

Course Content	
UNIT - I	1. Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. 2. Self-Discovery:Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. 3. Positivity and Motivation: Developing Positive Thinkingand Attitude; Driving out Negativity; Meaning andTheories of Motivation; Enhancing Motivation Levels.
UNIT-II	1. Interpersonal Communication: Interpersonal relations; communication models,process and barriers; team communication; developing interpersonal relationshipsthrough effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation. 2. Public Speaking:Skills, Methods, Strategies and Essential tips for effective public speaking.

	3. Non-Verbal Communication: Importance and Elements; Body Language.
UNIT-III	1. Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, OvercomingNervousness. 2. Group Discussion: Importance, Planning, Elements, Skills assessed; effectivelydisagreeing, Initiating, Summarizingand Attaining the Objective. 3. Interview Skills: Interviewer and Interviewee – in-depth perspectives. Before, During and After the Interview. Tips for Success. 4. Teamwork and Leadership Skills: Concept of Teams;Building effective teams; Concept of Leadership and honing Leadership skills
UNIT - IV	1. Etiquette and Manners – Social and Business. 2. Time Management – Concept, Essentials, Tips. 3. Personality Development – Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills. 4. Leadership and Assertiveness Skills: A Good Leader; Leaders and Managers; Leadership Theories; Types ofLeaders; Leadership Behaviour; Assertiveness Skills.
UNIT- V	1. Emotional Intelligence: Meaning, History, Features, Components, Intrapersonal and Management Excellence; Strategies to enhance Emotional Intelligence 2. Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods 3. Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. 4. Stress Management: Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models andImpact of Stress; Measurement and Management of Stress.

Text books :	
1.	Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill India, 2012.
2.	English and Soft Skills – S.P.Dhanavel, Orient BlackswanIndia, 2010
WEB RESOURCES	
1.	https://nptel.ac.in/courses/109107121/
2.	https://www.goskills.com/Soft-Skills

EARTHQUAKE RESISTANCE DESIGN

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T25
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	Structural Analysis	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To know the student with Engineering Seismology.
2	Equip student with concepts of Structural Dynamics and Understand Concepts of Seismic Design
3	To know the students with various IS codal provisions for ductile design and detailing andDesign philosophies for Seismic loading

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	To familiarize with seismic terminology basics; General considerations.	K1
CO2	Students acquire the ability to analyze single and multi-degrees of freedom systems of structures.	K4
CO3	To familiarize with seismic codal and detailing provisions.	K3
CO4	To familiarize with seismic codal philosophy	K3
CO5	To demonstrate the ability to design earthquake-resistant structures at various dynamic conditions.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	2	-	2	1	-	-	3	1	-
CO2	3	2	1	-	-	-	2	-	1	-	-	-	3	1	-
CO3	3	2	1	-	-	-	-	-	-	1	-	-	3	2	-
CO4	3	2	1	-	-	-	2	-	-	-	-	-	3	1	-
CO5	3	2	1	-	-	-	2	-	-	3	-	-	3	3	-

COURSE CONTENT	
UNIT I	**Seismic-resistant building architecture** Introduction; Lateral load resisting systems- moment resisting frame, building with shear wall or bearing wall system, building with dual system; Building configuration – Problems and solutions; Building characteristics – Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight, hyperstaticity/redundancy, non-structural elements, foundation soil/ liquefaction. Foundations; Quality of construction and materials – quality of concrete, construction joints, general detailing requirements.
UNIT II	**Design forces for buildings** Introduction; Equivalent static method; Mode superposition technique; Dynamic inelastic-time history analysis; Advantages and disadvantages of these methods; Determination of lateral forces as per IS 1893(Part 1) – Equivalent static method, Model analysis using response spectrum.
UNIT III	**Ductility considerations in earthquake resistant design of RCC buildings** Introduction; Impact of ductility; Requirements for ductility; Assessment of ductility– Member/element ductility, Structural ductility; Factor affecting ductility; Ductility factors; Ductility considerations as per IS13920.
UNIT IV	**Earthquake resistant design of a long two-storey, two-bay RCC building** Determination of lateral forces on an intermediate plane frame using Equivalent static method and Model analysis using response spectrum; Analysis of the intermediate frame for various load combinations as per IS1893(Part 1); Identification of design forces and moments in the members; Design and detailing of typical flexural member, typical column, footing and detailing of an exterior joint as per IS13920.
UNIT V	**Base isolation of structures** Introduction; Considerations for seismic isolation; Basic elements of seismic isolation; seismic-isolation design principle; Feasibility of seismic isolation; Seismic-isolation configurations.

TEXT BOOKS	
1.	Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2011.
2.	Seismic design of reinforced concrete and masonry buildings by T. Paulay and M.J.N. Priestley, John Wiley & Sons, 1st Edition 1992.
3.	The seismic design handbook, Edited by F. Naeim, Kluwer Academic publishers, 2001.
REFERENCE BOOKS	
1.	Introduction to the Theory of Seismology‟ by Bullen K.E., Great Britain at the University Printing houses, Cambridge University Press 1996.
2.	Relevant code of practic
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105101004

GROUND IMPROVEMENT TECHNIQUES

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T26
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	Geo-Technical Engineering.	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To make the student how to improve the properties of different soils by adopting different ground improvement techniques.
2	To make the student appreciate the need for different ground improvement methods adopted for improving the properties of remoulded and in-situ soils by adopting different techniques such as in situ densification and dewatering methods
3	To make the student understand how to stabilize the different types of poor quality soils, purpose and effects of grouting.
4	To enable the students to know how reinforced soil, geotextiles and geosynthetics can be used to improve the engineering performance of soils

COURSE OUTCOMES		**Cognitive**
Upon successful completion of the course, the student will be able to:		**Level**
CO1	Identify various problems associated with soil deposits, formulate and methods to evaluate them.	K2
CO2	Explain the concept involved for in-situ treatment of cohesive and cohesionless soils and ability required to design an appropriate techniques to implement ground improvement methods.	K2
CO3	Ability to design a dewatering system, component or process as per needs and specifications.	K3
CO4	Know the various functions of Geosynthetics and their applications in civil engineering practice.	K3
CO5	Design a reinforced earth embankment and check its stability, concepts and applications of grouting	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	2	2	3	1	2	2	3	2	2	1
CO2	2	3	3	2	3	1	2	3	1	3	2	3	3	3	3
CO3	3	3	2	2	2	2	2	2	3	1	2	2	3	1	2
CO4	3	2	3	3	1	1	3	1	2	3	3	3	2	2	3
CO5	3	2	3	3	3	1	3	1	2	3	3	3	3	2	2

COURSE CONTENT

UNIT I	**PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES** Role of ground improvement in foundation engineering – Methods of ground improvement Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.
UNIT II	**INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS** In-situ densification of cohesionless soils - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles- Installation techniques – Simple design - Relative merits of above methods and their limitations. separation, road works and containment application- Introduction to Liquefaction & its effects & applications.
UNIT III	**DEWATERING TECHNIQUES** - Well points – Vacuum and electroosmotic methods – Seepage analysis for two dimensional flow for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.
UNIT IV	**STABILIZATION OF SOILS** – methods of soil stabilization – mechanical – cement – lime – bitumen and polymer stabilization – use of industrial wastes like fly ash and granulated blast furnace slag. **GROUTING** – objectives of grouting – grouts and their applications – methods of grouting – stage of grouting – hydraulic fracturing in soils and rocks – post grout tests.
UNIT V	**REINFORCE EARTH** – principles – components of reinforced earth – design principles of reinforced earth walls – stability checks – soil nailing. **GEOSYNTHETICS** – geotextiles – types – functions , properties and applications – geogrids , geomembranes and gabions - properties and applications.

TEXT BOOKS	
1.	„Ground Improvement Techniques‟ by Purushotham Raj, Laxmi Publications, New Delhi. 2nd Edition 2015.
2.	„Ground Improvement Techniques‟ by NiharRanjanPatro ,Vikas Publishing House (p) limited , New Delhi. 1st Edition 2012.
3.	„An introduction to Soil Reinforcement and Geosynthetics‟ by G.L.Siva Kumar Babu, Universities Press. 1st Edition 2005.
REFERENCE BOOKS	
1.	Koerner, R.M., “Designing with Geosynthetics” (Fourth Edition), Prentice Hall, Jersey, 2012.
2.	Moseley, M.P., “Ground Improvement Blockie Academic and Professional”, Chapman and Hall, Glasgow, 2004.
WEB RESOURCES	
	https://archive.nptel.ac.in/courses/105105210/

RIVER MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T27
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Irrigation Engineering	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	Introduction of basic concepts of River Morphology.
2	To understand the basic concepts of models of River gauging.
3	To learn the sediment transportation and the loading conditions.
4	To analyze the Reservoir planning and sediment yield.
5	To learn and analyze the river bank stability and design of river training works.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Basic concepts of River Morphology and Characteristics of Rivers.	K1
CO2	Understanding the basic concepts of models of River Morphology and river gauging.	K1
CO3	Knowledge about the various aspects related to flow of water and sediments through natural and artificial channels and design aspects thereof.	K1
CO4	Analyze the Reservoir sedimentation and River training works.	K4
CO5	Explain about the stabilization, rectification of rivers and design of river training works	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	-	-	1	-	2	-	-	2	-	2	1	2
CO2	2	2	-	-	-	1	-	2	-	-	2	-	2	1	2
CO3	2	2	-	-	-	1	-	2	-	-	2	-	2	1	2
CO4	2	2	-	2	-	1	-	2	-	-	2	-	2	1	2
CO5	2	2	2	2	-	1	-	2	-	-	2	-	2	1	2

COURSE CONTENT	
UNIT I	River morphology, Plan form variations and river channel pattern, Characteristics of straight, braided and meandering rivers
UNIT II	River dynamics, River gauging, Analytical models of river morphology
UNIT III	Sediment transport in rivers, Bed load and suspended load transport for uniform and non-

	uniform bed material, Total load equations, sediment sampling, Alluvial streams and hydraulic design
UNIT IV	Reservoir planning, Reservoir sedimentation, River training works, Soil erosion and sediment yield
UNIT V	Principles of stabilization and rectification of rivers, River bank stability analysis, Design of river training works like groynes, guide banks, gabions, Hydraulic modelling of rivers

TEXT BOOKS	
1.	Garde, R.J., (2006), "River Morphology", New Age International Publishers
2.	Garde, R.J. and RangaRaju, K.G., (2006), "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastern Limited
REFERENCE BOOKS	
1.	Julien, Pierre, Y., (2002), "River Mechanics", Cambridge University Press Jansen, P.P.H., (1994), "Principals of River Engineering", VSSD Publications
WEB RESOURCES	
1.	https://onlinecourses.nptel.ac.in/noc21_ce70/preview

BIOREMEDIATION

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T28
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE OBJECTIVES	
1	To make students to get awareness on bioremediation technologies and to understand the importance and methods of treating the pollution naturally.
2	To make students understand the biological methods by using plants and microorganisms for the effective treatment of the toxic substances
3	To make students aware of the treatment mechanism and biological reactions in the plant body and microorganisms.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Gain basic understanding of bioremediation and bioreactors	K2
CO2	Gain knowledge of different types of bioremediation and different plants needed for treating the pollution	K1
CO3	Identify different microorganisms for treating the pollutants and understanding their genetic responses	K1
CO4	Understanding the detoxification and lab scale treatment methods for gaseous pollutants	K2
CO5	Gaining knowledge for bio-treatment methods for oil spills, bio monitoring and different types of reactors	K1
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	2	3	-	-	1	3	-	3	3	-	-	3	2
CO2	3	-	3	2	2	2	-	3	-	3	-	-	3	3	2
CO3	3	-	3	2	-	2	-	-	-	3	-	-	3	2	2
CO4	2	-	3	2	3	-	-	-	-	3	2	3	3	2	2
CO5	2	2	3	2	2	-	-	3	3	3	2	3	3	3	2

COURSE CONTENT	
UNIT I	**Bioremediation:** Definition – Principles of bioremediations, Factors of bioremediation-Bio augmentation for bioremediation, Bioreactors.
UNIT II	**Bioremediation strategies:** Remediation technologies - in situ and ex situ bioremediation-Advantages and disadvantages of bioremediation- Phytoremediation Technology for Soil decontamination.
UNIT III	**Microbial systems for bioremediation:** Genetic responses of microorganisms to the presence of pollutants- Application of genetically engineered microorganisms for waste management- Biological Treatment Technologies for Metals Remediation -Bioleaching and Biobenificiation –

	Bioaccumulation.
UNIT IV	**Microbial transformation reactions:** Microbial detoxification- bioremediation systems and processes-Microbial cleaning of gases- insitu bioremediation - lab scale bio treatability- Oxidation/Reduction Processes -Biological Methylation -Case studies.
UNIT V	**Bioremediation of herbicides, pesticides, hydrocarbons, oil spills:** Bioremediation of organic and inorganic pollutants-advances in microbial remediation- Sequestering Carbon Dioxide -Bio monitoring -Application of Microbial Enzymes -Bio membrane Reactors.

TEXT BOOKS	
1.	"Bioremediation: Applied microbial solutions for real world environment clean up" - Atlas R.M. and Philip J (Eds) - I edition. Amer Society of Microbiology, 2005
2.	"Bioremediation principles" - Ergas S.J., Chang, B.P.Y. Schreoder, E.D. and Eweis.J.B. WCB/ McGraw Hill, 1998.
REFERENCE BOOKS	
1.	"Handbook of bioremediation: Physical, Molecular and Biotechnological Interventions" - Mirza Hasanuzzaman, Majeti Narasimha Vara Prasad - Elsevier, 2020
2.	"Bioremediation Science: From Theory to Practice" - Amitava Rakshit, Manoj Parihar, Binoy Sarkar, Harikesh B. Singh, Leonardo Fernandes Fraceto - CRC Press, 2021
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105107173
2.	https://nptel.ac.in/courses/105107181

TRAFFIC ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T29
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Surveying	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE LEARNING OBJECTIVES	
1	To know various components and characteristics of traffic.
2	To know various traffic control devices and principles of highway safety.
3	To understand the detrimental effects of traffic on environment.
4	To know highway capacity and level of service concepts.
5	To learn about intelligent vehicle highway systems.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Discover Parking Problems and manage traffic regulations.	K1
CO2	Determine traffic speed, volume, travel time and Density.	K2
CO3	Design traffic signals.	K3
CO4	Discover traffic-environment problems.	K2
CO5	Build Knowledge of traffic Capacity and Level of service and developing vehicle highway systems.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	-	3	3	-	-	-	-	-	-	-	-	1	2	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-

COURSE CONTENT	
UNIT I	**COMPONENTS OF THE TRAFFIC SYSTEM:** Human-Vehicle–Environment System; characteristics of Road users, Vehicles, Highways and their classification; Traffic Studies: Inventories; Volume studies; Speed, Travel time and Delay studies; Intersection studies; Pedestrian studies; Parking studies; Accident studies. Types of parking facilities – On street parking and Off-street Parking facilities; Parking studies and analysis- Parking Inventory Study, Parking Usage Study By Patrolling, Questionnaire Survey, Cordon Surveys; Evaluation of parking parameters; Parking accumulation, Parking Load, Parking Turnover, Parking Volume, Parking Index.

UNIT II	**TRAFFIC CHARACTERISTICS:** Microscopic and macroscopic flow characteristics: Time headways; Temporal, spatial and model flow patterns; Interrupted and Un interrupted traffic. Microscopic and macroscopic speed characteristics: Vehicular speed Trajectories; Speed characteristics – Mathematical distribution; Speed and travel time variations; Travel time and delay studies. Microscopic and Macroscopic density characteristics: Distance headway characteristics; Car-following theories; Density measurement techniques; Density contour maps.
UNIT III	**TRAFFIC CONTROL DEVICES & HIGHWAY SAFETY:** Traffic signs & Markings; Signal Warrants; Signal phasing and Development of phase plans; Fixed and Vehicle activated signals; Webster method; ARRB method; Drew's Method; IRC method; Signal coordination; Area Traffic control. Accident characteristics – Road – Driver – Vehicle; Accident recording and Analysis; Highway Safety Improvement Program; Safety Audit.
UNIT IV	**ENVIRONMENTAL CONSIDERATIONS:** Air pollution: Kinds of pollutants; Air pollution standards; Measures of air quality; modelling and control. Noise pollution: Measurement of sound levels; Acceptable limits, Prediction of noise levels, Traffic noise control. Measures to curtail environmental degradation due to traffic.
UNIT V	**HIGHWAY CAPACITY AND LEVEL OF SERVICE:** Capacity and level of service; Factors affecting Capacity and LOS; Capacity of Rural Highways, Capacity of Urban Roads; HCM and IRC standards. **INTELLIGENT VEHICLE – HIGHWAY SYSTEMS:** Traffic surveillance and monitoring; IVHS programs, Role of IVHS, IVHS categories, Benefits and Costs of IVHS.

TEXT BOOKS	
1.	"Traffic Engineering: Theory and Practice" by Pignataro LJ., Prentice hall, Inc.
2.	"Traffic and Transport planning" by Kadiyali L.R., Khanna Publishers.
REFERENCE BOOKS	
1.	"Traffic Engineering Hand Book" by Institute of Transportation Engineers, 4 Ed., Prentice Hall.
2.	"Traffic Engineering" by Mc Shane, WR and RP Roess, Prentice Hall.
WEB RESOURCES	
1.	http://nptel.ac.in/courses/105101008/12

BRIDGE ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T30
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Structural analysis Design & Drawing of Steel structures.	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSEOBJECTIVES	
1	Familiarize Students with different types of Bridges and IRC standards.
2	Equip student with concepts and design of Slab Bridges, T Beam Bridges, Box Culverts
3	Understand concepts of design of Plate Girder Bridges.
4	Familiarizewithdifferentmethodsofinspectionofbridgesandmaintenance.

COURSEOUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	List out the types of Bridges with diagrams and Loading standards.	K1
CO2	Design of Slab bridges and suggest structural detailing.	K3
CO3	Design of T beam bridge.	K3
CO4	Design of Plate girder bridges, box culverts and suggest structural detailing.	K3
CO5	Organize for attending inspections and maintenance of bridges and prepare reports.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of program Outcomes(1-Low,2- Medium,3-High)															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	2	-	2	-	-	3	-	2	-	3
CO2	3	3	2	-	-	2	-	2	-	-	3	-	2	-	3
CO3	3	3	2	-	-	2	-	2	-	-	3	-	3	-	3
CO4	3	3	2	-	-	2	-	2	-	-	3	-	2	-	3
CO5	3	2	2	-	-	2	-	2	-	-	3	-	2	-	3

COURSECONTENT	
UNIT-I	**INTRODUCTION**- Bridges- Types- Slab bridges, T Beam, Arch bridges, Cable Stayedbridges, prestressed concrete bridges, Truss Bridges, Culverts, - Nomenclature- Selection ofBridge Site- Economical span- Abutments pier and end connections- types of foundations- Open,Pile,WellFoundations,Bearings–Types-IntroductiontoLoadingstandards-RailwayandIRCLoading.
UNIT-II	**SLAB BRIDGES**- Wheel load on slab- effective width method- slabs supported on two edges- cantilever slabs- dispersion length- Design of interior panel of slab- Guyon's –Massonet Method –Hendry-Jaegar Methods-Courbon's theory-Pigeaud's method.
UNIT-III	**T-BEAMBRIDGES**-Analysisanddesignofvariouselementsofbridge–Designofdeckslab,longitudinal girders and Secondary beams-Reinforcement detailing.
UNIT-IV	**PLATEGIRDERBRIDGES:** Elements of plate girder and their design-web- flange-intermediate stiffener- vertical stiffeners- bearing stiffener- Splices, Design problem with detailing. **BOXCULVERTS:** Loading–Analysis and Design-Reinforcement detailing.
UNIT-V	**INSPECTION AND MAINTENANCE OF BRIDGES**: Procedures and methods for inspection–Testing of bridges-Maintenance of Sub Structures and Superstructures-Maintenance of bearings-Maintenance Schedules.

TEXTBOOKS	
1.	"EssentialsofBridgeEngineering" byJhonsonVictorD,Oxford,6th Edition2019.
2.	"Designof BridgeStructures" byT.R.Jagadeesh,M.A.Jayaram,PHI,2nd edition,2009.
REFERENCEBOOKS	
1.	"BridgeEngineering"bySPonnuswamy, 3rd Edition, McGrawHilleducation,2017
2.	"Designof Bridges"byKrishnaRaju,4th editionbyworldwide bookstore,NewDelhi.

SOIL DYNAMICS & MACHINE FOUNDATION

DEPARTMENT OF CIVIL ENGINERING

Course Category	Professional Elective	**Course Code**	20CE7T31
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Geo-Technical Engineering	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Familiarize the fundamental behavior of geotechnical structures under dynamic loading
2	To understand the vibration analysis with interpretation of soils
3	Familiarize purposes of various laboratory and filed tests to determine the dynamic soil properties

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Understand the fundamental behavior of geotechnical structures under dynamic loading	K2
CO2	Understand the theories of vibration analysis	K2
CO3	Conduct various laboratory and filed tests to determine the dynamic soil properties and its interpretation	K3
CO4	Design the machine foundations	K3
CO5	Design vibration isolators under any vibratory machines and analysis of geotechnical structures under dynamic loads	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	2	-	2	1	-	-	3	1	-
CO2	3	2	1	-	-	-	2	-	1	-	-	-	3	1	-
CO3	3	2	1	-	-	-	-	-	-	1	-	-	3	2	-
CO4	3	2	1	-	-	-	2	-	-	-	-	-	3	1	-
CO5	3	2	1	-	-	-	2	-	-	3	-	-	3	3	-

COURSE CONTENT	
Unit - I	Introduction: Types of motion- SHM- Fundamental definitions- SDOF systems- Free and forced vibration with and without damping- Types of damping-Equivalent stiffness of springs in series and parallel- Principles of vibration measuring devices- Introduction to two and multi degree freedom systems
	Theories of Vibration Analysis- EHS Theory and lumped parameter model- Different

Unit - II	modes of vibration- Natural frequency of foundation soil system – Barkan and IS methods – Pressure bulb concept – Reisner Theory – Limitations of Reisner theory – Sung's solutions --Pauw's Analogy – Heigh's Theory.
Unit - III	Dynamic properties of soils, Determination of E, G and Poisons ratio from field and laboratory tests, recommendations of Indian codes- Stress waves in bounded elastic medium- Use of wave theory in the determination of elastic properties, Elastic coefficients of soils and their determination- damping factor from free and forced vibration tests.
Unit - IV	Machine Foundations: Classification based on the type of dynamic force and structural form, design data, design criteria, foundations for reciprocating, impact and high speed machined like turbo generators- IS code provisions for the design of the same
Unit - V	Vibration Isolation and Special Topics: Transmissibility, Principles of isolation- Methods of isolation- Vibration isolators- Types and their characterizes - Liquefaction of soils, Dynamic bearing capacity, Earth retaining structures under dynamic loads-Pile foundations with dynamic loads

TEXT BOOKS	
1.	Vibration Analysis and Foundation Dynamics, NSV Kameswara Rao, Wheeler Publishing, New Delhi.
2.	Vibrations of Soils and Foundations – Richart Hall and Woods
3.	Fundamentals of Soil Dynamics- B M Das
REFERENCE BOOKS	
1.	Foundations of Machines- Analysis and Design- Prakash and Puri
2.	Analysis and design of Foundations for Vibrations- P J Moore
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105101005

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IRRIGATION ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Course	**Course Code**	20CE7T32
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Water Resource Engineering	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To introduce the types and design of irrigation systems.
2	Discuss the relationships between soil, water and plant and their significance in planning an irrigation system
3	Understand design methods of erodible and non-erodible canals.
4	Know the principles of design of hydraulic structures on permeable foundations.
5	Know the concepts for analysis and design principles of storage, diversion head works and canal structures.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Demonstrate the irrigation types and methods.	K1
CO2	Design principles of Unlined and Lined canals.	K3
CO3	Estimate the life of reservoir and storage capacity.	K4
CO4	Apply the concepts of Bligh's creep theory and Khosla's theory.	K3
CO5	Apply the design principles of cross drainage works. Design of super passage and canal regulator.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	1	2	-	-	-	-	1	-	1	-	3
CO2	3	2	2	2	1	2	-	-	-	-	1	-	1	-	3
CO3	3	3	3	2	2	2	-	--	-	-	1	-	1	-	3
CO4	2	2	2	2	1	2	-	-	-	-	1	-	1	-	3
CO5	2	2	2	2	1	2	-	-	-	-	1	-	1	-	3

COURSE CONTENT	
UNIT I	IRRIGATION: Necessity and importance, principal crops and crop seasons, types, methods of application, soil-water-plant relationship, soil moisture constants, consumptive use, estimation of consumptive use, crop water requirement, duty and delta, factors affecting duty, depth and frequency of irrigation, irrigation efficiencies, water logging and drainage, standards of quality for irrigation water, crop rotation.

UNIT II	CANALS: Classification, design of non-erodible canals - methods of economic section and maximum permissible velocity, economics of canal lining, design of erodible canals – Kennedy's silt theory and Lacey's regime theory, balancing depth of cutting, design of lined canal. SPILLWAYS: Types, design principles of Ogee spillways, types of spillways crest gates. Energy dissipation below spillways-stilling basin and its appurtenances.
UNIT III	RESERVOIR PLANNING: Investigations, site selection, zones of storage, yield and storage capacity of reservoir, reservoir sedimentation. DAMS: Types of dams, selection of type of dam, selection of site for a dam. GRAVITY DAMS: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a dam, stability analysis, drainage galleries, grouting. EARTH DAMS: Types, causes of failure, criteria for safe design, seepage, measures for control of seepage-filters, stability analysis-stability of downstream slope during steady seepage and upstream slope during sudden drawdown conditions.
UNIT IV	DIVERSION HEAD WORKS: Types of diversion head works, weirs and barrages, layout of diversion head works, components. Causes and failures of weirs on permeable foundations, Bligh's creep theory, Khosla's theory, design of impervious floors for subsurface flow, exit gradient.
UNIT V	CANAL STRUCTURES FALLS: Types and location, design principles of Sarda type fall, trapezoidal notch fall and straight glacis fall. REGULATORS: Head and cross regulators, design principles. CROSS DRAINAGE WORKS: Types, selection, design principles of aqueduct, siphon aqueduct and super passage. OUTLETS: Types, Proportionality, Sensitivity and Flexibility. RIVER TRAINING: Objectives and approaches, interlocking system of rivers.

TEXT BOOKS	
1.	"Irrigation and Water Power Engineering" by Punmia B C, P.B.B Lal, A.K. Jain and A.K. Jain, Laxmi Publications Pvt. Ltd., New Delhi.7th Edition 2021
2.	"Irrigation Water Resources and Water Power Engineering" by Modi P N (2011), Standard Book House, NewDelhi. 7th Edition 2021
REFERENCE BOOKS	
1.	"Water Resources Engineering" by Mays L.W (2013), Wiley India Pvt. Ltd, New Delhi.
2.	"Irrigation Engineering" by Sharma R.K. and Sharma, T.K (2012), S.Chand& Co. Publishers.
3.	"Water Resources Engineering" by Satyanarayana Murthy Challa (2008), New Age International Publishers.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/126105010

AIR POLLUTION AND CONTROL

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T33
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Environmental Engineering	**Internal Assessment** **Semester End Examination** **Total Marks**	30 60 100

COURSE LEARNING OBJECTIVES	
1	To know the analysis of air pollutants
2	To know the Threshold Limit Values (TLV) of various air pollutants, acquire the design principles of particulate and gaseous control
3	To learn plume behaviour in different environmental conditions

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Decide the ambient air quality based the analysis of air pollutants	K2
CO2	The design principles of particulate and gaseous control measures for an industry.	K4
CO3	Judge the plume behaviour in a prevailing environmental condition	K2
CO4	Estimate carbon credits for various day to day activities.	K4
CO5	Estimate carbon credits for various day to day activities	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	2	-	2	1	-	-	3	1	-
CO2	3	2	1	-	-	-	2	-	1	-	-	-	3	1	-
CO3	3	2	1	-	-	-	-	-	-	1	-	-	3	2	-
CO4	3	2	1	-	-	-	2	-	-	-	-	-	3	1	-
CO5	3	2	1	-	-	-	2	-	-	3	-	-	3	3	-

COURSE CONTENT	
UNIT I	**Air Pollution:** Sampling and analysis of air pollutants, conversion of ppm into $\mu g/m^3$. Definition of terms related to air pollution and control - secondary pollutants - Indoor air pollution - Climate Change and its impact - Carbon Trade.

UNIT II	**Thermodynamics and Kinetics of Air-pollution**: Applications in the removal of gases like SOx, NOx, CO and HC - Air-fuel ratio- Computation and Control of products of combustion, Automobile pollution. Odour pollution control, Flares. **Meteorology and Air Pollution:** Properties of atmosphere: Heat, Pressure, Wind forces, Moisture and relative Humidity, Lapse Rates - Influence of Terrain and Meteorological phenomena on plume behavior and Air Quality - Wind rose diagrams, Plume Rise Models.
UNIT III	**Ambient Air Quality Management:** Monitoring of SPM, SO2; NOx and CO - Stack Monitoring for flue gases - Micro-meteorological monitoring - Weather Station. Emission Standards- Gaussian Model for Plume Dispersion.
UNIT IV	**Air Pollution Control:** Control of particulates – Control at Sources, Process Changes, Equipment modifications, Design and operation of control Equipments – Settling Chambers, Cyclone separators –Fabric filters– scrubbers, Electrostatic precipitators.
UNIT V	**Air Pollution Control Methods:** Control of NOx and SOx emissions – Environmental friendly fuels - In-plant Control Measures, process changes, methods of removal and recycling. Environmental criteria for setting industries and green belts.

TEXT BOOKS	
1	Air Pollution by M.N. Rao and H.V.N. Rao – Tata McGraw Hill Company.
2	Air Pollution and Control by KVSG Murali Krishna, Laxmi Publications, New Delhi.
REFERENCE BOOKS	
1	An Introduction to Air pollution by R.K. Trivedy and P.K. Goel, B.S. Publications.
2	Air pollution by Wark and Warner - Harper & Row, New York. 3rd Edition 1998.
WEB RESOURCES	
1	https://onlinecourses.nptel.ac.in/noc22_ce22/preview

PAVEMENT ANALYSIS & DESIGN

CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T34
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To know various factors affecting pavement design.
2	To know various concepts for the stresses in pavements.
3	To understand material characterization and mix design concepts.
4	To acquire design principles of flexible and rigid pavements.
5	To acquire design principles of shoulders, overlays and drainage.
6	To know various traffic control devices and principles of highway safety.
7	To understand the detrimental effects of traffic on environment.
8	To know highway capacity and level of service concepts.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Know the factors affecting the pavement design.	K2
CO2	Determine the stresses under the wheel loads.	K3
CO3	Know the concepts of material characterisation & mix design.	K2
CO4	Design of flexible pavements and rigid pavements.	K5
CO5	Design Of Shoulders, Overlays & Drainage.	K5
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO2	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO3	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO4	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO5	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3

COURSE CONTENT	
UNIT I	**Factors Affecting Pavement Design:** Variables Considered in Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles, Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane, Directional Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads

UNIT II	**Stresses In Pavements:** Vehicle-Pavement Interaction: Transient, Random & Damping Vibrations, Steady State of Vibration, Experiments on Vibration, Stress Inducing Factors in Flexible and Rigid pavements; Stress in Flexible Pavements: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts; Stresses in Rigid Pavements: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, Stresses in Dowel Bars & Tie Bars, Introduction to DAMA, KENLAYER & KENSLABS Programs.
UNIT III	**Material Characterisation & Mix Design Concepts:** CBR and Modulus of Subgrade Reaction of Soil, Mineral aggregates – Blending of aggregates, binders, polymer and rubber modified bitumen, Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties, Effects and Methods of Stabilisation and Use of Geo Synthetics; Marshall's and Hveem's Methods of Bituminous Concrete Mix Design, Field Implications of Stability and Flow Values, Introduction to Super Pave Mix Design, IRC Cement Concrete Mix Design.
UNIT IV	**Design of Flexible Pavements:** Flexible Pavement Design Concepts, Asphalt Institute's Methods with HMA and other Base Combinations, AASHTO, Road Note No 29 & IRC Methods, Design of Runways & Taxiways, Design of Low Volume Rural Roads. Serviceability Concepts, Visual Rating, Pavement Serviceability Index **Design Of Rigid Pavements**: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Introduction to Prestressed and Continuously Reinforced Cement Concrete Pavement Design, Rigid Pavement Design for Low Volume Rural Roads.
UNIT V	**Design Of Shoulders, Overlays & Drainage:** Shoulder Design Considerations, Traffic Prediction, Parking, Regular & Encroaching Traffic, Thickness Design Specifications for Flexible & Rigid Shoulders; Types & Design of Overlays: AI"s Principal Component Analysis & IRC Methods of Overlay Design, Importance of Profile Correction Course; Pavement Drainage Concepts, Drainage Related Failures, Inflow-Outflow Concepts, Condition of Continuity, Surface and Sub Surface Drainage Design Specifications.

TEXT BOOKS	
1.	"Pavement Analysis and Design" by Yang H. Huang, Pearson Education, Second Edition.
2.	Principles of Pavement Design" by Yoder.J. &Witczat Mathew, W. John Wiley & Sons Inc.
3.	Pavement Design" by Srinivasa Kumar R, Universities Press, Hyderabad.
4.	Traffic Engineering" by Mc Shane, WR and RP Roess, Prentice Hall.
REFERENCE BOOKS	
1.	"Design of Functional Pavements" by Nai C. Yang, McGraw HillPublications.
2.	"Concrete Pavements" by AF Stock, Elsevier, Applied Science Publishers.
3.	"Pavement and Surfacing's for Highway & Airports" by Micheal Sargious, Applied Science Publishers Limited.
4.	"Dynamics of Pavement Structures" by G. Martineek, Chapmen & HallInc.
5.	"Principles of Transportation Engineering" by PathaChakroborty and Animesh Das, PHI Learning Private Limited, Delhi.
6.	"Traffic Engineering - Theory & Practice" - Louis J. Pignataro, Prentice Hall Publication.
WEB RESOURCES	
1.	http://nptel.ac.in/syllabus/syllabus.php?subjectId=105105044
2.	http://nptel.ac.in/syllabus/syllabus.php?subjectId=105107064

PRESTRESSED CONCRETE

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional course	**Course Code**	20CE7T35
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Design and Detailing of Reinforced Concrete structures.	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	Familiarize Students with concepts of prestressing.
2	Equip student with different systems and devices used in prestressing.
3	Understand the different losses of prestress including short and long term losses.
4	Familiarize students with the analysis and design of prestressed concrete members under flexure, shear and torsion
5	To be able to understand the major difference between R.C.C & P.S.C Design

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Perceive the different methods of prestressing.	K1
CO2	Analyze and design prestressed concrete beams under flexure and shear Resistance.	K4
CO3	Understand the various losses in prestressed concrete systems.	K2
CO4	Evaluate the effective prestress including the short and long term losses.	K5
CO5	Understand the Anchorage Zone reinforcement.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of program

Outcomes (1 - Low, 2- Medium, 3-High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO2	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO3	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO4	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3
CO5	3	3	3	3	2	2	2	2	1	2	1	--	3	3	3

COURSE CONTENT	
UNIT-I	**INTRODUCTION:** Historic development – General principles of prestressing, pretensioning and post tensioning – Advantages and limitations of prestressed concrete – Materials – High strength concrete and high tensile steel their characteristics. I.S.Code provisions, Methods and Systems of Prestressing; Pre-tensioning and post tensioning methods – Analysis of post tensioning - Different systems of prestressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System.
UNIT-II	**ANALYSIS OF SECTIONS FOR FLEXURE:** Elastic analysis of concrete beams prestressed with straight, concentric, eccentric, bent and parabolic tendons. Concept of load balancing method, pressure line (Trust), Cracking moment for mid and end support conditions. **LOSSES OF PRESTRESS:** Loss of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage bending of member and frictional losses.
UNIT-III	**DESIGN FOR FLEXURAL RESISTANCE:** Design for Flexural resistance- Types of flexural failure – Code procedures-Design of sections for flexure- Control of deflections- Factors influencing- Prediction of short term and long term deflections.
UNIT-IV	**DESIGN FOR SHEAR AND TORSION**: Shear and Principal Stresses: Design of Shear reinforcements- Codal Provisions- Design for Torsion, Design for Combined bending, shear and torsion.
UNIT-V	**TRANSFER OF PRE-STRESS** Transfer of Prestress in pre-tensioned members- Transmission length- Bond stresses- End zone reinforcement- Codal provisions- Anchorage zone stresses in Post tensioned members- Stress distribution in End block- Anchorage Zone reinforcement.

TEXT BOOKS	
1.	"Prestressed Concrete" by N. Krishna Raju, Mc Grawhill Education: 6th Edition, 2018
2.	"Prestressed Concrete" by S. Ramamrutham, Dhanpat Rai publishing company, 5th Edition, 2013.
REFERENCE BOOKS	
1.	"Prestressed Concrete" by P. Dayaratnam, Medtech: 7th Edition, 2017
2.	"Prestressed Concrete" by T. Y. Lin & Burns, Wiley Publications.
WEB REFERENCES	
1.	https://nptel.ac.in/courses/105106117

EARTH & ROCK FILL DAMS

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T36
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To know suitability of materials for earth and rock fill dams.
2	To know the causes of failures.
3	To determine slope stability.
4	To know the different methods of slope stability.
5	To know the details of rock fill dams.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Able to design earth and rock fill dams.	K5
CO2	Get familiarity with slope stability calculations.	K1
CO3	Prevention techniques for slope failures.	K1
CO4	Analyze the slope stability using different methods.	K4
CO5	Able to know the various stability conditions and shear strength of rock fill dams	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	3	3	3	-	3	-	-	-	3	3	3
CO2	3	2	2	2	2	2	2	-	2	-	-	-	2	2	2
CO3	3	3	3	3	3	3	3	-	3	-	-	-	3	3	3
CO4	3	3	3	2	2	3	2	-	1	-	-	-	2	2	2
CO5	3	3	3	3	3	3	3	-	3	-	-	-	2	2	2

COURSE CONTENT	
UNIT I	Earth and Rock fill Dams: General features, Selection of site; Merits and demerits of the earth and rock fill dams, Classification of earth dams, Materials of construction and requirements, Causes of failure, Safe design criteria. Instrumentation in earth dams: Pore pressure measurements, Settlement gauges, Inclinometers, Stress measurements, Seismic measurements.
UNIT II	Failures, Damages and Protection of Earth Dams: Nature and importance of failure, Piping through embankment and foundations, Methods of seepage control through embankments and foundations, Design Criteria for filters, Treatment of upstream and downstream of slopes, Drainage control, Filter design.
UNIT III	Slope Stability Analysis: Types of Failure: Failure surfaces – Planar surfaces, Circular surfaces, Non-circular surfaces, Limit equilibrium methods, Total stress analysis versus effective Stress analysis, Use of Bishop's pore pressure parameters, Short term and Long term stability in slopes.
UNIT IV	Methods of Slope Stability: Taylor Charts, Method of Slices, Effect of Tension Cracks, Vertical Cuts. Bishop's Analysis, Bishop and Morgenstern Analysis, Non-circular Failure Surfaces: Morgenstern and Price Analysis, Janbu Analysis, Spencer Analysis, Sliding Block Analysis, Seismic stability, Stabilization of slopes: Drainage measures, Soil reinforcement (geosynthetics/soil nailing/micro piles etc), soil treatment (cement/lime/thermal treatment), surface protection (vegetation/erosion control mats/shotcrete).
UNIT V	Rock fill Dams: Requirements of compacted rock fill, Shear strength of rock fill, Rock fill mixtures, Rock fill embankments, Earth-core Rock fill dams, Stability, Upstream & Down stream slopes.

TEXT BOOKS	
1.	Christian, K. Earth & Rock fill Dams – Principles of Design and Construction, CRC Press, 1997.
2.	Sowers, G.F. – Earth and Rock fill Dam Engineering, Asia Publishing House, 1962.
REFERENCE BOOKS	
1.	Bharat Singh and Sharma, H. D. – Earth and Rock fill Dams, 1999
2.	Abramson, L. W., Lee, T. S. and Sharma, S. – Slope Stability and Stabilisation methods – John Wiley & sons. (2002)
3.	Sherard, Woodward, Gizienski and Clevenger. Earth and Earth-Rock Dams. John Wiley &. Sons. 1963.
4.	US Army Corp of Engineers, Earth and Rock-fill Dams, General Design and construction Considerations, University Press of the Pacific (2004)
5.	Bromhead, E. N. (1992). The Stability of Slopes, Blackie academic and professional, London.
WEB RESOURCES	
1.	https://archive.nptel.ac.in/courses/105/107/105107066/

WATER RESOURCE SYSTEM PLANNING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T37
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Water Resource Engineering	**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

COURSE LEARNING OBJECTIVES	
1	Introduce the concepts of system analysis in the planning, design, and operation of water resources.
2	Appreciate mathematical optimization methods and models.
3	Learn and apply basic economic analysis tools to water resources projects.
4	Understand linear, nonlinear and dynamic programming techniques and apply them to various water resources systems planning.
5	Appreciate simulation and management techniques in water resources systems.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Apply optimization methods related to water resource systems.	K3
CO2	Application of linear programming in water resources	K3
CO3	Simulate models for planning and design of Water Resources Systems.	K3
CO4	Understand the Non- Linear Optimization Techniques in water resources.	K2
CO5	Perform basic economic analysis to evaluate the economic feasibility of water resources projects.	K5
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	1	2	3	1	1	--	2	2	1	3	--	3
CO2	3	3	3	3	2	3	1	1	--	2	3	--	3	--	3
CO3	3	3	3	3	2	3	1	1	--	2	3	--	3	--	3
CO4	3	3	3	3	2	3	1	1	--	2	3	--	3	--	3
CO5	2	2	3	3	3	3	2	1	1	2	3	2	3	--	3

COURSE CONTENT	
UNIT I	Introduction: concepts of systems analysis, definition. Systems approach to water resource planning, role of optimization models, objective function and constraints, types of optimization techniques.
UNIT II	Linear programming: Formation of linear programming models, graphical methods, simplex method, application of linear programming in water resources. Revised simplex method, duality in linear programming, sensitivity and past optimality anal
UNIT III	Dynamic Programming: principles of optimality forward and backward recursive dynamic programming, case of dimensionality, application for resource allocation.
UNIT IV	Non- Linear Optimization Techniques: Critical method of optimization, Kuch – Tucleer, gradential based research techniques for simple unconstrained optimization.
UNIT V	Simulation: Application of simulation techniques in water resources. ii) Water Resource Economics: Principles of Economic analysis benefit – cost analysis socio economic intuitional pricing of water resources.

TEXT BOOKS	
1.	Water resource system analysis – Vedula&Mujumdar – Tata Mc. Graw hill company Ltd. 2005.
2.	Water resources Economics – James & Lee. Oxford publi
REFERENCE BOOKS	
1.	Optimal design of water distribution networks P.R.Bhave, Narosi publishing house 2003.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/105108081

ENVIRONMENTAL IMPACT ASSESSMENT & MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Elective	**Course Code**	20CE7T38
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	-----	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To impart knowledge on different concepts of Environmental Impact Assessment.
2	To know procedures of risk assessment.
3	To learn the EIA methodologies and the criterion for selection of EIA methods.
4	To pre-requisites for ISO 14001certification
5	To know the procedures for environmental clearances and audit.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Prepare EMP, EIS, and EIA report	K3
CO2	Identify the risks and impacts of a project	K2
CO3	Selection of an appropriate EIA methodology	K2
CO4	Evaluate the EIA report	K5
CO5	Estimate the cost benefit ratio of a project	K5
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	1	1	-	2	3	3	2	2	-	3	2	1
CO2	2	-	-	-	-	2	-	-	2	-	1	2	3	2	2
CO3	2	3	3	-	1	-	-	2	1	-	-	-	-	2	2
CO4	2	2	3	-	2	-	-	2	-	-	2	2	2	2	2
CO5	-	-	2	2	-	2	-	-	2	-	2	-	2	2	2

COURSE CONTENT	
UNIT I	**BASIC CONCEPT OF EIA:** Elements of EIA - Factors affecting EIA - Initial Environmental Examination - life cycle analysis, Preparation of Environmental Base map - Classification of environmental parameters – Role of stakeholders in the EIA preparation – Stages in EIA.
UNIT II	**EIA METHODOLOGIES**: Introduction, Criteria for the selection of EIA Methodology, EIA methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, Overlay methods, cost/benefit Analysis - EIS and EMP.
UNIT III	**IMPACT OF DEVELOPMENTAL ACTIVITIES AND LAND USE**: Introduction and Methodology for the assessment of soil and ground water, Delineation of study area, Identification of actives - Application of remote sensing and GIS for EIA.
UNIT IV	**PROCUREMENT OF RELEVANT SOIL QUALITY**: Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures - EIA with reference to surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment.
UNIT V	**ASSESSMENT OF IMPACT OF DEVELOPMENT ACTIVITIES**: Vegetation and wildlife, Environmental Impact of Deforestation, EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Procedure for environmental clearance, evaluation of EIA report. Environmental legislation objectives, Evaluation of Audit data and preparation of Audit report.

TEXT BOOKS	
1.	Environmental Impact Assessment, Canter Larry W.,McGraw-Hill education 2nd Edition (1996)
2.	Environmental Impact Assessment Methodologies, by Y.Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad. 2nd Edition, 2011.
3.	Environmental Science and Engineering, by Suresh K.Dhaneja – S.K.Katania&Sons Publication, NewDelhi. 2013.
REFERENCE BOOKS	
1.	Environmental Science and Engineering, by J. Glynn and Gary W.HeinKe – Prentice Hall Publishers.
2.	Environmental Pollution and Control, by Dr H.S. Bhatia – Galgotia Publication (P) Ltd., NewDelhi.
WEB RESOURCES	
1.	**https://onlinecourses.nptel.ac.in/noc22_ar07/preview**

BATTERY MANAGEMENT SYSTEMS AND CHARGING STATIONS
(Open Elective – III offered to other departments)

Course Category	Professional Core Courses	**Course Code**	20EE7T29
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	**NIL**	**Internal Assessment Semester** **End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
1	To discuss about the different types of batteries.
2	To describe about the battery characteristic & parameters.
3	To apply the concepts of battery management system and design the battery pack.
4	To explain about the battery testing, disposal and recycling.
5	To describe different methods of EV charging

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Discuss about the different types of batteries.	K2
CO2	Describe about the battery characteristic & parameters.	K2
CO3	Apply the concepts of battery management system and design the battery pack.	K3
CO4	Explain about the battery testing, disposal and recycling.	K2
CO5	Describe different methods of EV charging	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	1	1	-	1	1	1	-	-	-	-	1	1	1
CO4	2	-	-	-	1	1	1	-	-	-	-	1	1	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1	1	1

COURSE CONTENT	
UNIT 1	**Batteries** Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System Suggested reading: Study of different types of batteries

UNIT 2	**Battery Characteristics & Parameters** Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.
UNIT 3	**Battery Pack and Battery Management System** Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests
UNIT 4	**Battery Testing, Disposal & Recycling** Chemical & structure material properties for cell safety and battery design, battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.
UNIT 5	**Charging Stations** Electric Vehicle Technology and Charging Equipment's, Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating, AC charging and DC charging, Inboard and off board charger specification, Type of Mode of charger Mode -2, Mode-3 and Mode-4, EVSE associated charge times calculation.

TEXT BOOKS	
1	Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
2	Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2)
REFERENCE BOOKS	
1	Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", John Wiley& Sons Ltd., 2016.
2	Chris Mi, Abul Masrur & David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
3	G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)"
4	T R Crompton, "Battery Reference Book-3 rd Edition", Newnes- Reed Educational and Professional Publishing Ltd., 2000.

5	James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/108106170
2	https://www.youtube.com/watch?v=omnQN5Z5vsA

ADDITIVE MANUFACTURING

(Open Elective – III offered to other departments)

Course Category	Open Elective	**Course Code**	20ME7T28
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
Students will learn	
1	Fundamentals of rapid prototyping and concepts of liquid-based rapid prototyping systems
2	Concepts of solid-based rapid prototyping systems
3	Concepts of powder-based rapid prototyping systems
4	Different rapid tooling processes
5	Rapid prototyping data formats and applications of additive manufacturing in various industries

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the rapid prototyping fundamentals & choose different liquid based rapid prototyping processes for manufacturing	K2
CO2	Choose different solid based rapid prototyping processes for manufacturing	K2
CO3	Choose different powder based rapid prototyping processes for manufacturing	K2
CO4	Choose different rapid tooling processes for prototyping manufacturing	K2
CO5	Elaborate the uses of additive manufacturing processes in various industries.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO2	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	1	2	2	1	-	-	-	-	-	-	-	1	2	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-	1	-
CO5	1	-	-	-	1	-	-	-	-	-	-	-	1	-

COURSE CONTENT

UNIT I

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Photopolymers, photo polymerization, layering technology, laser and laser scanning. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three-dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies

UNIT IV

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT V

ENHANCING ADDITIVE MANUFACTURING WITH REVERSE ENGINEERING: Reverse engineering, uses of reverse engineering, Steps for reverse engineering in additive manufacturing, 3D scanning techniques.

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis.

TEXT BOOKS

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003

REFERENCE BOOKS

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

WEB RESOURCES

1. nptel.ac.in/courses/112104204/47
2. nptel.ac.in/courses/112107078/37
3. https://www.youtube.com/watch?v=kNz-TM4zPkE&list=PLbTLRuAivTCR0YVCNxSTPI9lgccanmZLG
4. https://lecturenotes.in/m/46059-note-of-additive-manufacturing-by-madhura-diwakar?reading=true
5. https://www.slideshare.net/badebhau/additive-manufacturing-processes-pdf-by-badebhau4gmailcom

INDUSTRIAL ELECTRONICS

(Open Elective – III offered to other departments)

Course Category	Open Elective	**Course Code**	20EC7T40
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	Basic Electrical and Electronics Engineering	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
Student will learn	
1	The building block for differential amplifier and operational amplifier using DC amplifiers and applications of OP-AMP.
2	A Voltage Regulator ,Types of Voltage Regulators and their working and use of a different voltage regulators for real time applications
3	The characteristics and operation of SCR and Thyristor and techniques to turn Off a Thyristor
4	The operation and applications of important switching devices such as DIAC and TRIAC much used in power electronics
5	The different electronic devices such as Electronic timers and Electronic DC Motor and Control, Electric Welding methods, high frequency heating ,ultrasonic generation required for industrial applications

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Understand the concept of DC amplifiers.	K2
CO2	Analyze and design different voltage regulators for real time applications	K2
CO3	Describe the basis of SCR and Thyristor	K2
CO4	Determine the performance of DIAC and TRIAC	K2
CO5	Develop real time application using electronics	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	**1**	-	-	-	-	-	-	-	1	-
CO2	2	2	2	-	-	-	-	-	-	-	1	1
CO3	2	2	2	-	-	-	-	-	-	-	1	1
CO4	2	2	2	-	-	-	-	-	-	-	1	1
CO5	2	2	2	-	-	-	-	-	-	-	1	1

COURSE CONTENT	
UNIT I	**DC Amplifiers:** Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers - Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.
UNIT II	**Regulated Power Supplies:** Block diagram, Principle of voltage regulation, Series and Shunttype Linear Voltage Regulators, Protection Techniques - Short Circuit, Over voltage and Thermal Protection. Switched Mode & IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting
UNIT III	**SCR and Thyristor:** Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F, Ratings of SCR.
UNIT IV	**Applications of SCR in Power Control:** Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave. DIAC, TRIAC and Thyristor Applications: Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation
UNIT V	**Industrial Applications -I:** Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital Timers, Time base Generators. Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control. **Industrial Applications –II**: High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications

TEXT BOOKS	
1.	Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2.	Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972
REFERENCE BOOKS	
1.	Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edition, 2003
2.	Thyristors and applications – M. Rammurthy, East-West Press, 1977.
WEB RESOURCES	
1.	https://nptel.ac.in/courses/108102145

BIG DATA ANALYTICS

(Open Elective – III offered to other departments)

Course Category	Professional Core	**Course Code**	**20DS6T02**
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Data Mining	**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSEOBJECTIVES	
1	To optimize business decisions and create competitive advantage with Big Data analytics
2	To learn to analyze the big data using intelligent techniques
3	To introduce programming tools PIG & HIVE in Hadoop echo system

COURSEOUTCOMES		**Cognitive level**
Upon successful completion of the course, the student will be able to:		
CO1	Illustrate big data challenges in different domains including social media, transportation, finance and medicine	K2
CO2	Enumerate and apply the features of Cassandra	K2
CO3	Design and develop Hadoop and Map Reduce programs	K3
CO4	Perform data analysis using Apache Spark	K2
CO5	Analyze the data analytics process with a case study	K3
K1:Remember,K2:Understand,K3:Apply,K4:Analyze,K5:Evaluate,K6:Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1–Low,2-Medium,3– High)

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	-	-	-	-	-	-	-	1	1	1
2	3	1	1	2	2	-	-	-	-	-	-	1	-	-	1
3	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1
4	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1
5	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1

COURSECONTENT	
UNITI	**Types of Digital Data:** Classification of Digital Data. Introductionto Big Data: Characteristic of Data, Evolution of Big Data,Definition of Big Data, Challenges with Big Data, What is BigData? **Big Data Analytics:** Where do we Begin?, What is BigData Analytics?, What Big Data Analytics isn't?, Classification ofAnalytics, Terminologies Used in Big Data Environments. TheBig Data Technology Landscape: NoSQL.**(Text Book 1)**
UNITII	**Introduction to Cassandra:** Apache Cassandra – An Introduction,Features of Cassandra, CQL Data Types, CQLSH, Keyspaces,CRUD, Collections, Using a Counter, Time to Live, AlterCommands, Import and Export.**(Text Book 1)**
UNITIII	**Hadoop** : Hadoop Overview, HDFS (Hadoop Distributed File System),Processing Data with Hadoop, Managing Resources andApplications with Hadoop YARN (Yet another ResourceNegotiator). **MAPREDUCE:**Introduction to MAPREDUCE Programming: Introduction,Mapper, Reducer, Combiner, Partitioner, Searching, Sorting,Compression.**(Text Book 1)**
UNITIV	**Introduction to Data Analysis with Spark**: What is Apache Spark,A unified Spark, Who uses Spark and for what?, A Brief Historyof Spark, Spark version and releases, Storage layers for Spark. **Programming with RDDs:** RDD Basics, Creating RDDs, RDDOperations, Passing functions to Spark, Common Transformationsand Actions, Persistence.**(Text Book 2)**
UNITV	**JasperReport using Jaspersoft:** Introduction to JasperReports, Connecting to MongoDB NoSQL Database, Connecting to Cassandra NoSQL Database. **Few Interesting Differences:** Difference between Data Warehouse and Data Lake, Difference between RDBMS and HDFS, Difference between HDFS and HBase, Difference between Hadoop MapReduce and Spark, Difference between Pig and Hive**(Text Book 1)**

TEXTBOOKS	
1.	Big Data and Analyticsby Seema Acharya,SubhashiniChellappan, Second Edition, Wiley India Pvt. Ltd., 2019
2.	Learning Spark:Lightning-Fast Big DataAnalysisby Andy Konwinski,Holden Karau,MateiZaharia,Patrick Wendell, First Edition, O'Reilly, 2015

REFERENCEBOOKS	
1.	Big Data Analytics, by RadhaShankarmani, MVijayalakshmi, Second Edition, Wiley India Pvt. Ltd., 2016
2.	Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.
3.	Hadoop: The Definitive Guideby Tom White, O'Reilly Media, Inc., 2009
4.	Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons, 2014.

WEBRESOURCES	
1.	http://hadoop.apache.org/
2.	https://nptel.ac.in/courses/106104189/
3.	https://www.edx.org/course/big-data-fundamentals
4.	https://www.coursera.org/specializations/big-data/
5.	https://www.wileyindia.com/big-data-and-analytics-2ed.html

ORGANIZATIONAL BEHAVIOUR
(Open Elective – III offered to other departments)

CourseCategory	Humanities including Management	**Credits**	20HM7T09
Course Type	Theory	**Lecture-Tutorial-Practice**	3 -0 -0
Prerequisites		**Internal Assessment**	30
		Semester End Examination	70
		Total Marks	100

Course Outcomes		**Blooms Taxonomy Level**
On successful completion of the course, the student will be able to		
CO 1	Understand the meaning and importance of Organizational Behaviour to start and survive in corporate environment.	K2
CO 2	Demonstrate how the perception can integrate in human behaviour , attitudes and values.	K2
CO 3	Understand the importance of Groups and Teams in organizations for better Decision making.	K2
CO 4	Understand the need for change and its importance in organizations.	K2
CO 5	Understand the culture of organizations and to apply techniques in dealing with stress in organizations.	K3
K1:Remember,K2:Understand,K3:Apply,K4:Analyze,K5:Evaluate,K6:Create.		

Contribution of Course Outcomes towards achievement of Program

Outcomes: 1 – Low, 2 - Medium, 3 – High

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	0	0	0	0	1	0	2	2	2	0	2
CO2	0	0	0	0	0	1	0	3	2	3	0	2
CO3	0	0	0	0	0	1	0	2	3	3	0	2
CO4	0	0	0	0	0	1	0	3	3	2	0	2
CO5	0	0	0	0	0	3	0	1	2	2	0	2

COURSE CONTENT :

Unit-I Introduction to Organizational Behaviour

Concept-Nature and scope-Importance of Organizational Behaviour-Key elements of Organizational Behaviour-Role of managers in Organizational Behaviour-Approaches to Organizational Behaviour-Perspectives of Human Behaviour-Challenges and Opportunities for Organizational Behaviour.

Unit-II Perceptual Management

Nature-Process of Perception- Organization and Interpretation-Influencing factors- Importance of

Perception in OB - Perceptual Errors- Attitudes and Values –Changes and Behaviour Modification Techniques-Impression Management.

Unit-III Introduction to Groups and Teams

Meaning –Importance of Groups - Foundations of Group Behaviour –Reasons for Group formation-Group and Team-Types of Groups-Stages of Group development –Meaning and Importance of Teams-Factors affecting Group and Team performance-Types of teams-Creating an effective Team.

Unit-IV Organization Change and Development

Definition and Meaning - Need for change-Forces for changes in Organization-Types of change-Organizational Resistance-Strategies overcome Resistance-Process of change-Meaning and Definition of Organization Development-OD interventions.

Unit-V Organizational Culture and Organizational Stress

Organizational culture: Meaning and Nature of Organizational Culture-Functions-Types-Creating and maintain Organizational Culture-Managing Cultural Diversity. Organizational Stress: Definition and Meaning-Sources of stress-Impact of stress on organizations-Stress Management Techniques.

Text Books:

1. K.Aswathappa: "Organizational Behaviour-Text, Cases and Games", Himalaya Publishing House, New Delhi, 2017,
2. Stephen P. Robbins, Timothy, A. Judge: "Essentials of Organizational Behaviour" Pearson,2017
3. Pareek Udai, Sushma Khanna: "Understanding Organizational Behaviour", Oxford University Press, New Delhi, 2016.

References:

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2015
2. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma: "Organizational Behavior", Tata McGraw Hill Education, New Delhi, 2017.
3. Jerald Greenberg and Robert A Baron: "Behavior in Organizations", PHI Learning Private Limited, New Delhi, 2013.
4. Jai B.P.Sinha: "Culture and Organizational Behavior", Sage Publication India Private Limited, New Delhi, 2009.
5. New strom W. John& Davis Keith, Organisational Behaviour--Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.

Web Resources

1.https://www.diversityresources.com/cultural-diversity-workplace/

2.https://www.chanty.com/blog/problem-solving-techniques/

3.https://www.simplypsychology.org/perspective.html#:~:text=The%20five%20major%20perspectives%20in,%2C%20behavioral%2C%20cognitive%20and%20humanistic

4.https://theintactone.com/2019/06/18/mpob-u3-topic-6-perception-process-and-errors

SMART GRID TECHNOLOGIES

(Open Elective – IV offered to other departments)

Course Category	Professional Core Courses	**Course Code**	20EE7T30
Course Type	Theory	**L-T-P-C**	**3-0-0-3**
Prerequisites	**NIL**	**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
1	To understand the basic concepts of smart grid.
2	To understand various smart grid technologies and its usage in smart applications.
3	To realize substation automation with intelligent sensors and have an idea on battery energy storage systems.
4	To have basic knowledge on micro grids and DG's.
5	To have an idea on communication technologies used in smart grid.

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Know the concepts of smart grids and analyze the smart grid policies and developments in smart grids.	K2
CO2	Analyze the concepts of smart grid technologies in hybrid electrical vehicles etc.	K4
CO3	Know the concepts of smart substations - feeder automation - Battery Energy storage systems etc.	K2
CO4	Analyze micro grids and distributed generation systems.	K4
CO5	Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.	K4
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1	1	1	1	1	-	-	-	-	1	2	2
CO2	3	2	1	1	1	1	1	-	-	-	-	1	2	2
CO3	3	2	1	1	1	1	1	-	-	-	-	1	2	2
CO4	3	2	1	1	1	1	1	-	-	-	-	1	2	2
CO5	3	2	1	1	1	1	1	-	-	-	-	1	2	2

COURSE CONTENT	
UNIT 1	**Introduction to Smart Grid** Evolution of Electric Grid - Concept of Smart Grid - Definitions - Need of Smart Grid - Functions of Smart Grid - Opportunities & Barriers of Smart Grid - Difference between conventional & smart grid - Concept of Resilient & Self-Healing Grid - Present development & International policies on Smart Grid.
UNIT 2	**Smart Grid Technologies-1** Introduction to Smart Meters - Real Time Pricing - Smart Appliances - Automatic Meter Reading(AMR) - Outage Management System(OMS) - Plug in Hybrid Electric Vehicles(PHEV) - Vehicle to Grid - Smart Sensors - Home & Building Automation - Phase Shifting Transformers - Net Metering.
UNIT 3	**Smart Grid Technologies- 2** Smart Substations - Substation Automation - Feeder Automation. Geographic Information System(GIS) - Intelligent Electronic Devices (IED) & their application for monitoring & protection. Smart storage like Battery Energy Storage Systems (BESS) - Super Conducting Magnetic Energy Storage Systems (SMES) - Pumped Hydro - Compressed Air Energy Storage (CAES)
UNIT 4	**Micro grids and Distributed Energy Resources** Concept of micro grid - need & applications of microgrid - formation of microgrid - Issues of interconnection - protection & control of microgrid - Integration of renewable energy sources - Demand Response.
UNIT 5	**Information and Communication Technology for Smart Grid** Advanced Metering Infrastructure (AMI) - Home Area Network (HAN) - Neighborhood Area Network (NAN) - Wide Area Network (WAN).

TEXT BOOKS	
1	Integration of Green and Renewable Energy in Electric Power Systems - by Ali Keyhani - Mohammad N. Marwali - Min Dai Wiley - 2009.
2	The Smart Grid: Enabling Energy Efficiency and Demand Response - by Clark W.Gellings - Fairmont Press - 2009.
REFERENCE BOOKS	
1	The Advanced Smart Grid: Edge Power Driving Sustainability:1 by Andres Carvallo - John Cooper - Artech House Publishers July 2011
2	Control and Automation of Electric Power Distribution Systems (Power Engineering) by James Northcote - Green - Robert G. Wilson - CRC Press - 2017.
3	Substation Automation (Power Electronics and Power Systems) by MladenKezunovic - Mark G. Adamiak - Alexander P. Apostolov - Jeffrey George Gilbert - Springer - 2010.
4	Electrical Power System Quality by R. C. Dugan - Mark F. McGranghan - Surya Santoso -H. Wayne Beaty - McGraw Hill Publication - 2nd Edition.
WEB RESOURCES (Suggested)	
1	https://nptel.ac.in/courses/108107113
2	https://electrical-engineering-portal.com/smart-grid-concept-and-characteristics

SUSTAINABLE ENERGY TECHNOLOGIES

(Open Elective – IV offered to other departments)

Course Category	Open Elective	**Course Code**	20ME7T38
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	NIL	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To demonstrate the importance and solar radiation, solar energy collection and storage
2	To understand the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy
3	To interpret energy efficient electrical and mechanical systems
4	To develop energy efficient processes
5	To understand features and benefits of green buildings

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate the importance and solar radiation, solar energy collection and storage.	K2
CO2	Understand the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy.	K2
CO3	Analyze energy efficient electrical and mechanical systems.	K2
CO4	Understand features and benefits of green buildings.	K2
CO5	Understand the different types of unconventional machining methods and principles of finishing processes.	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	3	-	-	-	3	-	3	-	-	2
CO2	3	2	2	-	3	-	-	-	3	-	3	-	-	2
CO3	3	2	2	-	3	-	-	-	3	-	3	-	-	2
CO4	3	2	3	-	3	-	-	-	3	-	3	-	-	2
CO5	3	2	3	-	3	-	-	-	3	-	3	-	-	2

COURSE CONTENT

UNIT I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy.

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.

UNIT III

ENERGY EFFICIENT SYSTEMS:

ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.

MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, environmentally friendly and Energy efficient compressors and pumps**.**

UNIT IV

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmentally friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

UNIT V

GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmentally friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

TEXT BOOKS

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013

REFERENCE BOOKS

1. Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering - D.YogiGoswami, Frank Krieth & John F Kreider/Taylor & Francis
3. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
4. Renewable Energy Technologies -Ramesh & Kumar /Narosa
5. Non conventional Energy Source- G.D Roy/Standard Publishers

Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt. Ltd

BIO-MEDICAL INSTRUMENTATION

(Open Elective – IV offered to other departments)

Course Category	OE	**Course Code**	20EC7T41
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Basics of Analog circuits	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES: In this course the student will	
1	Study the physiological relation of human body – environment and Identify various errors that occur while measuring living system
2	Study various types of Electrodes and Transducers used in biomedical measurements
3	Learn Anatomy of Heart, Respiratory system and the measuring instruments.
4	Learn various fundamental blocks in patient care and monitoring
5	Study various diagnostic and therapeutic techniques

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Acquainted with the function of human body and measure active and resting potentials of cell bodies.	K2
CO2	Measure the Bioelectric potential using appropriate electrodes and Transducers.	K2
CO3	Know the mechanism and measurement of ECG for the Cardiac cycle and respiratory system	K2
CO4	Monitor the Patient care monitoring system and applications of therapeutic equipment	K2
CO5	Know the working principles of diagnostic equipment	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	1	1	2	-	-	-	-	-	-	-	-	-	-	1
CO4	-	1	2	2	-	-	-	-	-	-	-	-	-	1
CO5	-	1	1	1	2	-	-	-	-	-	-	-	1	-

COURSE CONTENT	
UNIT I	**INTRODUCTION TO BIOMEDICAL INSTRUMENTATION:** Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Problems Encountered in Measuring a Living System, Bioelectric Potentials, Resting and Action Potentials, Propagation of Action Potential, Bioelectric Potentials-ECG, EEG and EMG, Bio amplifiers
UNIT II	**ELECTRODES AND TRANSDUCERS:** Introduction to Electrode Theory, Biopotential Electrodes, Examples of Electrodes, Basic Transducer principles, Biochemical Transducers, The Transducer and Transduction principles, Active Transducers, Passive Transducers.
UNIT III	**CARDIOVASCULAR SYSTEM AND MEASUREMENTS:** The Heart and Cardiovascular System, Electro Cardiography, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Measurement of Heart sound, Plethysmography, Angiogram and Angioplasty **RESPIRATORY SYSTEM AND MEASUREMENTS:** The Physiology of the Respiratory System, Tests and Instrumentation for the Mechanics of Breathing, Respiratory Therapy Equipment.
UNIT IV	**PATIENT CARE AND MONITORING:** Elements of Intensive-Care Monitoring, Patient Monitoring Displays, Diagnosis, Calibration and Repair ability of Patient-Monitoring equipmentOther Instrumentation for Monitoring Patients, Pacemakers, Defibrillators, Ventilators, Radio Frequency applications of Therapeutic use, ECG & EEG Recorders.
UNIT V	**DIAGNOSTIC TECHNIQUES AND BIO-TELEMETRY:** Principles of Ultrasonic Measurement, Ultrasonic imaging, Ultrasonic Applications of Therapeutic uses, Ultrasonic diagnosis, X-Ray and Radio-Isotope instrumentations, CAT Scan, Emission Computerized Tomography, MRI, and Telemedicine Technology.

TEXT BOOKS	
1.	Fundamentals of biomedical instrumentation –Dr.O.N.Pandey, S.K.Kataria & sons,4 th edition,2012
2.	Bio-Medical Instrumentation – Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, 2nd edition, PHI, 2011.
REFERENCE BOOKS	
1.	Hand Book of Bio-Medical Instrumentation – R.S.Khandapur, McGrawHill, 2nd edition, 2003.
2.	Biomedical Instrumentation – Dr. M. Arumugam, Anuradha Publications, 2006
WEB RESOURCES	
1.	http://www.digimat.in/nptel/courses/video/108105101/L28.html/

CRYPTOGRAPHY AND NETWORK SECURITY

(Open Elective – IV offered to other departments)

Course Category	Professional Core	**Course Code**	20IT7T10
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	**30** **70** **100**

COURSE OBJECTIVES	
The objective of the course is to	
1	The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPsec, and SSL/TLS.

COURSE OUTCOMES		**Cognitive level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain different security threats and countermeasures and foundation course of cryptography mathematics.	K1
CO2	Classifythebasicprinciplesofsymmetrickeyalgorithmsandoperationsofsomesymmetrickeyalgorithmsandasymmetrickeycryptography	K2
CO3	RevisethebasicprinciplesofPublickeyalgorithmsandWorkingoperationsofsomeAsymmetrickeyalgorithmssuchasRSA,ECCandsomemore	K2
CO4	Design applications of hash algorithms, digital signatures and key management techniques	K3
CO5	DeterminetheknowledgeofApplicationlayer,TransportlayerandNetworklayersecurityProtocolssuchasPGP,S/MIME,SSL,TSL,andIPsec	K2
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	1	2	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	1	2	-	-	-	-	-	-	-	2	2	2
CO3	3	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO4	3	2	3	3	3	-	-	-	-	-	-	-	1	1	2
CO5	3	2	3	3	3	-	-	-	-	-	-	-	1	1	2

COURSE CONTENT	
UNIT I	Basic Principles: Security Goals, Cryptographic Attacks, Services andMechanisms, Mathematics of Cryptography.

UNIT II	Symmetric Encryption: Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.
UNIT III	Asymmetric Encryption: Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography
UNIT IV	Data Integrity,Digital Signature Schemes & Key Management:Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.
UNIT V	Network Security-I: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, Network Security-II : Security at the Network Layer: IPSec, System Security

TEXT BOOKS	
1.	Cryptography and Network Security, 3rd Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill,2015
2.	Cryptography and Network Security,4thEdition, William Stallings, (6e) Pearson,2006
3.	Everyday Cryptography, 1stEdition, Keith M.Martin, Oxford,2016
REFERENCE BOOKS	
1.	Network Security and Cryptography, 1st Edition, Bernard Meneges, Cengage Learning,2018.

MARKETING MANAGEMENT
(Open Elective – IV offered to other departments)

CourseCategory	Humanities including Management	**Credits**	3
CourseType	Theory	**Lecture-Tutorial-Practice**	3 -0 -0
Prerequisites		**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

Course Outcomes		**Blooms Taxonomy Level**
On successful completion of the course, the student will be able to		
CO 1	Understand the concepts of Marketing and Marketing Environment.	Understanding
CO 2	Analyze the consumer behavior and market segmentation in order to maintain better consumer relations and product positioning respectively.	Analyzing
CO 3	Make use of strategies and make decisions based on product life cycle and product mix concepts.	Application
CO 4	Understand the pricing effects and select a better distribution channel to reach the consumer.	Understanding
CO 5	Understand the promotional methods and importance.	Understanding
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program

Outcomes: 1 – Low, 2 - Medium, 3 – High

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	0	2	0	0	1	1	1	0	1	1	0
CO2	0	0	1	0	0	1	0	2	1	0	1	0
CO3	0	0	1	2	1	2	1	1	0	0	1	1
CO4	0	0	1	0	0	1	0	1	0	0	1	0
CO5	0	0	0	0	0	1	1	1	1	1	1	1

COURSE CONTENT :

Unit -I

Introduction to Marketing: Market and Marketing, Functions,importance and problems of marketing – Marketing Environment, Approaches to the study of marketing – Institutional Approach, Commodity approach, Management approach, systems approach to marketing.Marketing Mix(7 p's of Marketing.)

Unit -II

Consumer Behavior and CRM

Meaning and features and Factors influencing Consumer Behavior – Theories of Buying Behavior

(Economic theories – Marshallion model, psychological theories, psycho-analytic theories, socio-cultural theories) – buying decision process - Customer Relationship Management.
Market Segmentation
Market Segmentation – Bases of Segmenting Consumer Market and Industrial Market – Target Marketing – Product differentiation – Product Positioning.

Unit -III
Product decision: New product development – Product mix – management of product life cycle – product strategies – product additions and deletions.
Branding, packaging and labeling – product differentiation – planned obsolescence.

Unit –IVPricing and Channels of distribution:
Pricing: Pricing objectives – Pricing methods – Pricing strategies.
Channels of Distribution: Nature and types of marketing channels – wholesale distribution- retail distribution – direct marketing – selection of channels, Logistics, Third Party Service providers.

Unit –VPromotion :
Nature and Importance of promotion – promotional methods of personal selling : objectives and function, Advertising objectives – Message content – media selection – Advertising agency – Advertising Budgets – Measuring Advertising effectiveness; Sales promotion Techniques – Social Media Promotion

Textbooks:
1. Phil T.Kotler –Marketing Management - Pearson Education limited – 2019
2. S.A.Sherlekar – Marketing Management - Himalaya Publishing House - 2019
3. Dr. K.Karunakaran – Marketing Management Himalaya Publishing House – 2010.

Reference Books :
1. Priyanka Goel - Marketing Management – Atlantic publications - 2019.
2.Philip Kotler and Lane Keller - Marketing Management – Pearson Educaion ltd - 2017
3.L.Natarajan – Marketing Management – Margham Publications - 2012

Web Resources:
1. https://www.tutorialspoint.com/marketing_management/marketing_management_functions
2. https://keydifferences.com/difference-between-branding-and-packaging.html
3. https://smallbusiness.chron.com/product-mix-639.html

SURVEYING

OPEN ELECTIVE (OFFERED TO OTHER BRANCHES)

Course Category	Open Elective	**Course Code**	20CE6T01
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	----------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	Introduce the students to basic principles of surveying.
2	Demonstrate the basic surveying skills.
3	Perform various methods of linear and angles measurements.
4	Enable the students to use surveying equipment's
5	Integrate the knowledge and produce topographical map.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Illustrate the fundamentals in chain and plane table surveying.	K2
CO2	Identify the angles on filed by compass survey.	K2
CO3	Apply knowledge of leveling in surveying.	K3
CO4	Measure the horizontal and vertical angles by using Theodolite and Total Station instruments.	K3
CO5	Estimate the volume and area of irregular boundaries of filed.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	--	--	1	--	--	--	--	3	--	--	2	3	--	3
CO2	3	3	1	2	--	--	--	--	2	--	--	3	3	--	3
CO3	2	--	--	3	--	--	--	--	3	--	--	--	2	--	2
CO4	2	3	1	3	3	--	--	--	3	--	--	3	3	--	3
CO5	3	3	3	3	--	--	--	--	--	--	--	3	3	3	3

COURSE CONTENT	
UNIT I	**INTRODUCTION:** Definition-Uses of surveying, Objectives, Principles and Classifications of Surveying – Errors in survey measurements. **DISTANCEMEASUREMENTCONVENTIONS AND METHODS:** Use of chain and tape, Errors and corrections to linear measurements, overview of plane table surveying.

UNIT II	**COMPASS SURVEY:** Definition- Principles of Compass survey - Meridians, Azimuths and Bearings, declination. Computation of angle - Purpose and types of Traversing - traverse adjustments – Local attraction.
UNIT III	**LEVELING:** Concept and Terminology, Levelling Instruments and their Temporary and permanent adjustments- method of levelling. **CONTOURING:** Characteristics and uses of contours- methods of conducting contour surveys and their plotting.
UNIT IV	**THEODOLITE:** Theodolite, description, principles - uses – temporary and permanent adjustments, measurement of horizontal and vertical angles. Principles of Electronic Theodolite – Omitted Measurements. Introduction to geodetic surveying - Total Station and Global Positioning System. **CURVES:** Types of curves, design and setting out. **TACHEOMETRIC SURVEYING:** Stadia and tangential methods of Tachometry. **MODERN SURVEYING METHODS:** Principle and types of E.D.M. Instruments, Total station advantages and Applications. Introduction to Global Positioning System.
UNIT V	**COMPUTATION OF AREAS AND VOLUMES:** Computation of areas along irregular boundaries and regular boundaries. Embankments and cutting for a level section and two-level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits.

TEXT BOOKS	
1.	Surveying (Vol No.1, 2 &3) by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) ltd, New Delhi.
2.	Text book of Surveying by C. Venkataramaiah, University press, India (P) limited.
REFERENCE BOOKS	
1.	Text book of Surveying by S.K. Duggal (Vol No. 1&2), Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2.	Text book of Surveying by Arora (Vol No. 1&2), Standard Book House, Delhi.
WEB RESOURCES	
1.	https://lecturenotes.in/notes/2827-note-for-surveying-1-s-1-by-swadhina-priyadarsini
2.	https://nptel.ac.in/courses/105107122/1
3.	https://nptel.ac.in/courses/105107158/

DISASTER MANAGEMENT

OPEN ELECTIVE (OFFERED TO OTHER BRANCHES)

Course Category	Open Elective	**Course Code**	20CE6T40
Course Type	Theory	**L-T-P-C**	3-1-0-3
Prerequisites	----------	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE OBJECTIVES	
1	To provide basic conceptual understanding of disasters.
2	To understand approaches of Disaster Management.
3	To build skills to respond to disaster.
4	To understand to reduce the intensity of future disasters.
5	To understand the Restoration of human life in the region.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Knowledge on characteristics of natural disasters	K1
CO2	Planning on approaches of Disaster Management	K3
CO3	Ability to plan and design the new skills in disaster response	K6
CO4	Role of remote sensing system in disaster area response	K2
CO5	Knowledge on the Restoration of human life in the region.	K1
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO2	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO3	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO4	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1
CO5	2	2	3	--	1	1	--	--	--	--	2	--	3	1	1

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COURSE CONTENT	
UNIT I	**Natural Hazards and Disaster Management**: Introduction of DM – Inter disciplinary nature of the subject– Disaster Management cycle – Five priorities for action. Case study methods of the following: Vegetal Cover floods, droughts – Earthquakes – landslides – global warming, cyclones & Tsunamis – Post Tsunami hazards along the Indian coast.

UNIT II	**Man Made Disaster and Their Management Along With Case Study Methods Of The Following:** Fire hazards – transport hazard dynamics – solid waste management – post disaster – bio terrorism -threat in mega cities, rail and aircraft accidents, ground water, industries - Emerging infectious diseases and Aids and their management.
UNIT III	**Risk and Vulnerability:** Building codes and land use planning – Social Vulnerability – Environmental vulnerability – Macro-economic management and sustainable development, Climate change risk rendition – Financial management of disaster – related losses
UNIT IV	**Role of Technology in Disaster Managements:** Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations-roads and bridges mitigation programme for earth quakes – flowchart, geospatial information in agriculture drought assessment - Multimedia Technology in disaster risk management and training - Transformable Indigenous Knowledge in disaster reduction – Role of RS & GIS
UNIT V	**Multi-sectional Issues, Education and Community Preparedness:** Impact of disaster on poverty and deprivation - Climate change adaptation and human health - Exposure, health hazards and environmental risk-Forest management and disaster risk reduction -The Red cross and red crescent movement - Corporate sector and disaster risk reduction- Education in disaster risk reduction Essentials of school disaster education - Community capacity and disaster resilience-Community based disaster recovery - Community based disaster management and social capital-Designing resilience- building community capacity for action

TEXT BOOKS	
1.	"Disaster Management guide lines", GOI-UND Disaster Risk program (2009-2012)
2.	Modh S. (2010) "Managing Natural Disasters", Mac Millan publishers India LTD.
REFERENCE BOOKS	
1.	Murty D.B.N. (2012) "Disaster Management", Deep and Deep Publication PVT.Ltd. New Delhi
WEB RESOURCES	
	https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

HIGHWAY ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional course	**Course Code**	20CE5T11
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Surveying	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To introduce the students with the principles and practice of transportation engineering which focuses on Highway Engineering.
2	Ability to mathematically develop and interpret design standards for horizontal and vertical geometry and super elevation
3	To provide basic knowledge on materials used in pavement construction.
4	To enable the students to have a strong analytical and practical knowledge of Planning, Designing of Pavements.
5	To provide basic knowledge in traffic engineering, and transportation planning.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Plan highway network for a given area.	K3
CO2	Design the Highway geometrics based on highway alignment.	K3
CO3	Characterize the pavement materials like aggregates, Bituminous materials &construction.	K2
CO4	Judge suitability of pavement materials and design flexible and rigid pavements.	K5
CO5	Design Intersections and prepare traffic management plans.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-

COURSE CONTENT	
UNIT I	**Highway Planning and Alignment:** Highway development in India; Classification of Roads; Road Network Patterns; Necessity for Highway Planning; Different Road Development Plans – First, second, third road development plans, road development vision 2021, Rural Road Development Plan – Vision 2025; Planning Surveys; Highway Alignment- Factors affecting Alignment- Engineering Surveys – Drawings and Reports.
UNIT II	**Highway Geometric Design:** Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements-Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance- Design of Horizontal Alignment- Design of Super elevation and Extra widening- Design of Transition Curves- Design of Vertical alignment- Gradients- Vertical curves.
UNIT III	**Highway Materials:** Sub-grade soil: classification –Group Index – Subgrade soil strength –California Bearing Ratio – Modulus of Subgrade Reaction. Stone aggregates: Desirable properties – Tests for Road Aggregates – Bituminous Materials: Types – Desirable properties -Tests on Bitumen .
UNIT IV	**Design of Pavements:** Types of pavements; Functions and requirements of different components of pavements; Design Factors **Flexible Pavements:** Design factors – Flexible Pavement Design Methods – CBR method – IRC method – Burmister method – Mechanistic method – IRC Method for Low volume Flexible pavements. **Rigid Pavements:** Design Considerations – wheel load stresses – Temperature stresses – Frictional stresses – Combination of stresses – Design of slabs – Design of Joints – IRC method – Rigid pavements for low volume roads – Continuously Reinforced Cement Concrete Pavements – Roller Compacted Concrete Pavements.
UNIT V	**Traffic Engineering:** Basic Parameters of Traffic-Volume, Speed and Density- Traffic Volume Studies; Speed studies –spot speed and speed & delay studies; Parking Studies; Road Accidents- Causes and Preventive measures - Condition Diagram and Collision Diagrams; PCU Factors, Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Types of Intersections; At-Grade Intersections – Design of Plain, Flared, Rotary and Channelized Intersections; Design of Traffic Signals –Webster Method –IRC method.

TEXT BOOKS	
1.	Highway Engineering' by Paul H. Wright and Karen K Dixon, Wiley India (P)Ltd., New Delhi,John Wiley & Sons; 7th Edition (2003)

2.	Highway Engineering' by Khanna S.K., Justo C.E.G and Veeraragavan A, Nem Chand Bros,10th Edition (2005), Roorkee.
REFERENCE BOOKS	
1.	Transportation Engineering and Planning' by Papacostas C.S. and PD Prevedouros, Prentice Hall ofIndia Pvt. Ltd;Pearson; 3rd edition (2000), New Delhi.
2.	'Highway Engineering' by Srinivasa Kumar R, Universities Press (India) Private Limited (16 December 2020),Hyderabad.
WEB RESOURCES	
1.	https://nptel.ac.in/downloads/105101087/

WATER RESOURCE ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course Category	Professional Core	**Course Code**	20CE6T18
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Hydraulics and Hydraulic Machinery	**Internal Assessment** **Semester End Examination** **Total Marks**	30 70 100

COURSE LEARNING OBJECTIVES	
1	To introduce hydrologic cycle and its relevance to civil engineering.
2	Make the students understand physical processes in hydrology and, components of the hydrologic cycle.
3	Appreciate concepts and theory of physical processes and interactions.
4	Learn measurement and estimation of the components hydrologic cycle.
5	Provide an overview and understanding of Unit Hydrograph theory and its analysis.
6	Understand flood frequency analysis, design flood, flood routing.
7	Appreciate the concepts of groundwater movement and well hydraulics
8	Learn overview of flood routing and its effects.
9	Has to be understood and identify the flood occurring areas nearby.

COURSE OUTCOMES		**Cognitive Level**
Upon successful completion of the course, the student will be able to:		
CO1	Explain the theories and principles governing the hydrologic processes and list out the forms of precipitation in real conditions.	K1
CO2	Apply key concepts to several practical areas of engineering hydrology and related design aspects.	K2
CO3	Design major hydrologic components for a need-based structures.	K4
CO4	Estimate flood magnitude and carry out flood routing.	K5
CO5	Demonstrate the recuperation test process in open wells.	K3
K1: Remember, K2: Understand, K3: Apply, K4: Analyze, K5: Evaluate, K6: Create.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO2	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO3	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO4	3	2	2	2	2	2	--	--	--	--	1	--	1	--	2
CO5	3	2	2	2	1	2	--	--	--	--	1	--	1	--	2

COURSE CONTENT	
UNIT I	INTRODUCTION: Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data. Precipitation: Types and forms, measurement, rain gauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data, Frequency of point rainfall, Rain fall data in India. Intensity-Duration-Frequency (IDF) curves, Depth-Area Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm, problems on average rainfall on towns
UNIT II	ABSTRACTIONS FROM PRECIPITATION: Introduction, Initial abstractions. EVAPORATION: Factors affecting, measurement, reduction, Analytical methods of Evaporation estimation. EVAPOTRANSPIRATION: Factors affecting, measurement, control, Potential Evapotranspiration over India. INFILTRATION: Factors affecting, Infiltration capacity curve, measurement, Infiltration Indices. Problems on ϕ-Index and W-Index.
UNIT III	RUNOFF: Catchment characteristics, Factors affecting runoff, components, computation-empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve. HYDROGRAPH ANALYSIS: Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, synthetic unit hydrograph. Problems on unit hydrograph.
UNIT IV	FLOODS: Causes and effects, frequency analysis - Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management, Design flood, Design storm. FLOOD ROUTING: Hydrologic storage routing, channel and reservoir routing- Muskingum and Puls methods of routing, flood control in India. ADVANCED TOPICS IN HYDROLOGY: Rainfall-Runoff Modelling, Instantaneous Unit Hydrograph (IUH) - Conceptual models - Clark and Nash models, general hydrological models- Chow - Kulandaiswamy model.
UNIT V	GROUNDWATER: Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, specific capacity, permeability, transitivity and storage coefficient, types of wells, well loss, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of a open well-recuperation test.

TEXT BOOKS	
1.	"Engineering Hydrology" by Subramanya, K, Tata McGraw-Hill Education Pvt. Ltd, (2013), NewDelhi.
2.	"Engineering Hydrology" by Jayarami Reddy, P, Laxmi Publications Pvt. Ltd., (2013), New Delhi.

3.	"Irrigation and Water Power Engineering" by Punmia B C, P.B.B Lal, A.K. Jainand A.K. Jain (2009), Laxmi Publications Pvt. Ltd., New Delhi.
REFERENCE BOOKS	
1.	'Water Resources Engineering', Mays L.W, Wiley India Pvt. Ltd, (2013).
2.	'Hydrology' by Raghunath. H.M., New Age International Publishers,(2010).
3.	'Engineering Hydrology –Principles and Practice' by Ponce V.M., Prentice Hall International,(1994).
4.	'Hydrology and Water Resources Engineering' by Patra K.C., Narosa Publications,(2011).
5.	'Applied hydrology' by Chow V.T., D.R Maidment and L.W. Mays, Tata McGraw Hill Education Pvt.Ltd., Transportation Engineering-Id., (2011), NewDelhi.
6.	'Engineering Hydrology' by Ojha C.S.P, R. Berndtsson and P. Bhunya, Oxford University Press,(2010).
WEB REFERENCES	
1.	https://www.digimat.in/nptel/courses/video/105104103/L01.html