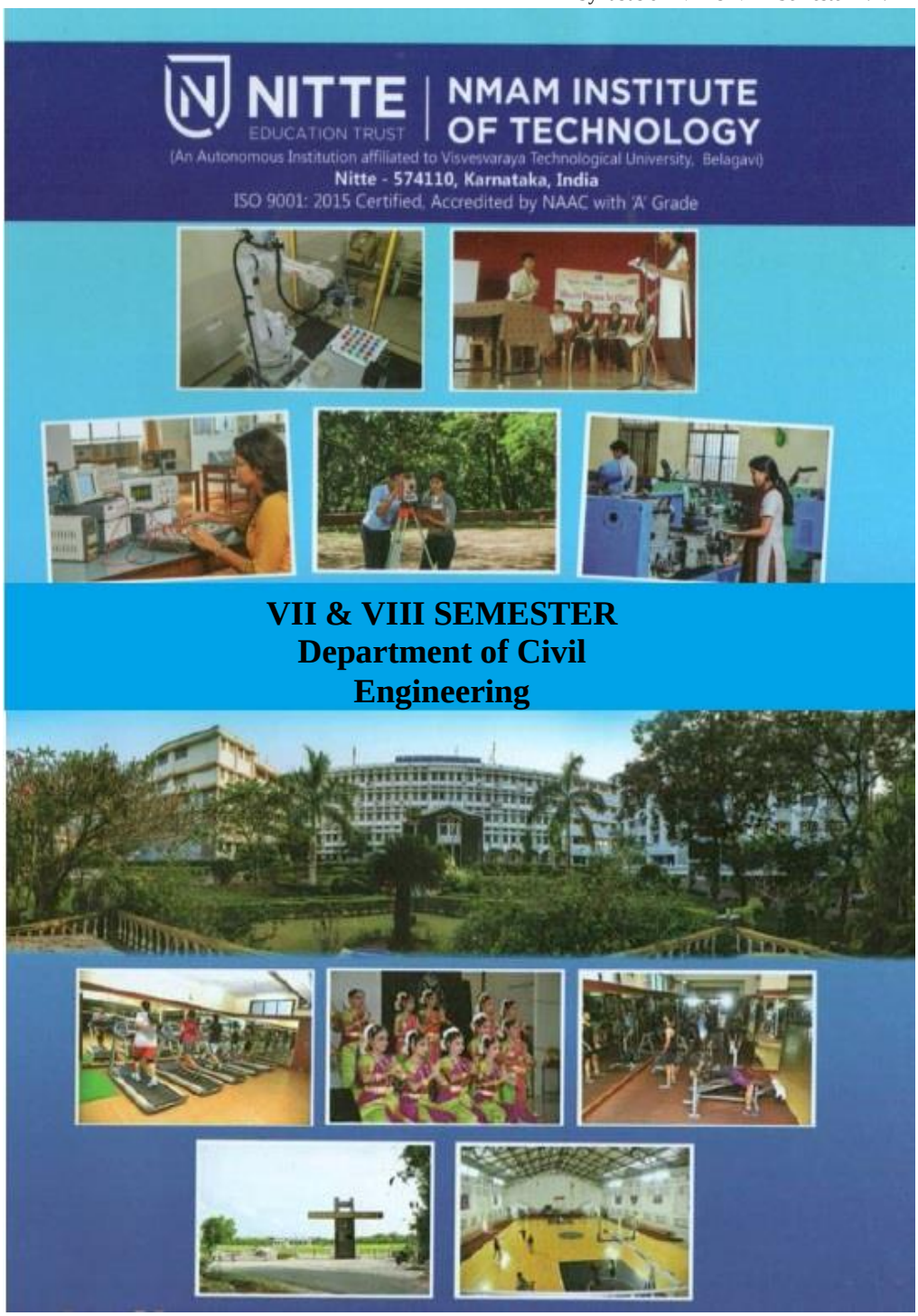
NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

College Calendar 2024-25

Department of Civil Engineering

Syllabus of 4th Year



College Calendar 2024-25

मातेव रक्षति पितेव हिते नियुङ्क्ते
कान्तेव चापि रमयत्यपनीय खेदम् ।
लक्ष्मीं तनोति वितनोति च दिक्षु कीर्तिं
किं किं न साधयति कल्पलतेव विद्या ॥

ಮಾತೇವ ರಕ್ಷತಿ ಪಿತೇವ ಹಿತೇ ನಿಯುಂಕ್ತೇ
ಕಾಂತೇವ ಚಾಪಿ ರಮಯತ್ಯಪನೀಯ ಖೇದಮ್ ।
ಲಕ್ಷ್ಮೀಂ ತನೋತಿ ವಿತನೋತಿ ಚ ದಿಕ್ಷು ಕೀರ್ತಿಂ
ಕಿಂ ಕಿಂ ನ ಸಾಧಯತಿ ಕಲ್ಪಲತೇವ ವಿದ್ಯಾ ॥

ತಾಯಿಯಂತೆ ರಕ್ಷಣೆಯನ್ನಿತ್ತು, ತಂದೆಯಂತೆ ಸನ್ಮಾರ್ಗದಲ್ಲಿ ತೊಡಗಿಸಿ ಪತ್ನಿಯಂತೆ ದುಃಖವನ್ನು ದೂರಮಾಡಿ ಮನಕ್ಕೆ ಮುದಕೊಡುತ್ತಾ, ಸಂಪತ್ತನ್ನು ವರ್ಧಿಸಿ ದಶದಿಕ್ಕುಗಳಲ್ಲಿ ಕೀರ್ತಿಯನ್ನು ಪಸರಿಸುವ 'ವಿದ್ಯೆ', ಕಲ್ಪಲತೆಯಂತೆ ನಾವು ಬಯಸಿದ್ದನ್ನು ಕೊಡುತ್ತಾಳೆ.

विद्या माता की तरह पालन करती है, बाप के तरह हितकर मार्ग में ही ले लेता है। पत्नी की तरह हमारा दुःख दूर करता है। मन को संतोष देता है, धन देती है, दिशाओं में कीर्ति फ़ैलाती है । कल्पवल्ली की तरह वह सब कामनाये पूरी करती है ।

Do you know in how many ways the 'Knowledge' serves his master? Like mother it protects, like father it teaches and guides, like wife, provides all kinds of happiness after destroying all sorrows, it brings wealth from every corner and spreads the fame in all direction. Like 'Kalpalatha' knowledge offers everything to human being whatever he wishes.

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to VTU, Belgavi)
NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India
ISO 9001:2015 Certified, Accredited by NAAC with "A" Grade

COLLEGE CALENDAR
2024-25
(VII & VIII Semester)

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

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Vision Statement

Pursuing Excellence, Empowering people, Partnering in CommUNITy Development

Mission Statement

To develop N.M.A.M. Institute of Technology, Nitte, as Centre of Excellence by imparting Quality Education to generate competent,
Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges
with Credibility, Integrity, Ethics and Social Concern.

In Memorium

Late Nitte Mahalinga Adyanthaya

Our Founder

Late Justice K. S. Hegde

1909-1990

SRI N. VINAYA HEGDE

President, Nitte Education Trust
Chancellor, Nitte (Deemed to be University), Mangaluru

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

Sl.No.	Name of the Faculty	Designation
1.	Dr. N. Niranjan Chiplunkar	Principal
2.	Mr. Yogeesh Hegde	Director(CM&D)
3.	Dr. Shrinivasa Rao B. R.	Vice Principal/Controller of Examinations/Professor
4.	Dr. I. Ramesh Mithanthaya	Vice Principal / Dean (Academic)/Professor
5.	Dr. Sudesh Bekal	Dean (R&D)/Professor
6.	Dr. Rajesh Shetty K.	Dean (Admissions)/Professor
7.	Dr. Rekha Bhandarkar	Deputy Registrar of Nitte Off-campus Centre, Nitte (DU)
8.	Dr. Subrahmanya Bhat K	Deputy COE of Nitte Off-campus Centre, Nitte (DU)
9.	Dr. Nagesh Prabhu	Director(Curriculum Development) Nitte (DU)
10.	Dr. Srinath Shetty K.	Resident Engineer/Professor
11.	Dr. Narasimha Bailkeri	Dean(Student Welfare)/Professor
12.	Dr. Rajalakshmi Samaga BL	PG Coordinator/Professor

HEADS OF DEPARTMENTS

1.	Dr. Arun Kumar Bhat	HoD, Civil Engg.
2.	Dr. Jyothi Shetty	HoD, Comp. Science & Engg
3.	Dr. Ashwini B	HoD, Information Science & Engg
4.	Dr. Ujwal P	HoD, Biotechnology
5.	Dr. KVSSSS Sairam	HoD, E&C Engg.
6.	Dr. Suryanarayana K	HoD, E&E Engg.
7.	Dr. Muralidhara	HoD, Robotics & Artificial Intelligence
8.	Dr. Kumudakshi	HoD, Mathematics
9.	Dr. Shobha R. Prabhu	HoD, Physics
10.	Dr. Shivaprasad Shetty M.	HoD, Chemistry
11.	Dr. Mamatha Balipa	HoD, MCA
12.	Dr. Vishwanatha	HoD, Humanities
13.	Dr. Radhakrishna	HoD, Computer & Communication Engg
14.	Dr. Sharada Uday Shenoy	HoD, Artificial Intelligence & Machine Learning

15.	Dr. Srinivas Pai P	HoD, Mechanical Engg
16.	Dr. Venugopala PS	HoD, Artificial Intelligence & Data Science
17.	Dr. Roshan Fernandes	HoD, Cyber Security
18.	Dr. Durgaprasad	Incharge ACT
19.	Dr. Sushma	Incharge VLSI
20.	Mr. Bharath G Kumar	Head, Training & Placement Cell

INCHARGE OF INSTITUTION'S RESPONSIBILITIES

1.	Dr. Gururaj Upadhyaya	Workshop Suptd
2.	Dr. Joy Elvine Martis	1st year Coordinator
3.	Dr. Jnaneshwar Pai Maroor	Co-ordinator Alumni
4.	Dr. Venkatesh Kamath	Assistant CoE
5.	Dr. Janardhan Nayak	Co-ordinator – Red Cross UNIT -
6.	Mr. Srinivas Nekkar	NCC Officer
7.	Mr. Krishnaraja Joisa	Public Relation Officer
8.	Mr. K. Sathish Nayak	Digital Media Executive
9.	Dr. Shashikanth Karinka	Student Welfare Officer
10.	Dr. Vijeesh	Director (R&D)

ENTREPRENEURSHIP DEVELOPMENT CELL

1.	Dr. Ramakrishna B	Professor/EDC- Incharge
2.	Mrs. Geetha Poojarthi	Co-ordinator

DEPARTMENT OF TRAINING & PLACEMENT

1.	Mr. Ankith S Kumar	Counsellor
2.	Dr. Abhishek Bhardwaj	T&P Associate

DEPARTMENT OF MATHEMATICS

1.	Dr. Shashirekha B. Rai	Professor
2.	Dr. Kumudakshi	Asso. Professor/ HoD
3.	Dr. Sharad M. Hegde	Asst. Professor Gd III
4.	Dr. Vasanth K.R	Asst. Professor Gd III
5.	Dr. Ashwini Kumari	Asst. Professor Gd III

6.	Dr. Chaithra K.	Asst. Professor Gd III
7.	Dr. Prashanthi K S	Asst. Professor Gd III
8.	Dr. Girija K P	Asst. Professor Gd III
9.	Dr. Ganesh Kumar K	Asst. Professor Gd III
10.	Mrs. Ambika N.	Asst. Professor Gd I
11.	Mrs. Vinaya Acharya	Asst. Professor Gd I
12.	Mrs. Anitha D. Bayar	Asst. Professor
13.	Mrs. Bhavya K.	Asst. Professor
14.	Mrs. Bhavya. D.	Asst. Professor
15.	Mrs. Sharmila	Asst. Professor
16.	Mrs. Anjana Pai K	Asst. Professor
17.	Mrs. Soumya	Asst. Professor
18.	Mrs. Smitha G. V.	Asst. Professor

DEPARTMENT OF PHYSICS

1.	Dr. Manjunath K. B.	Professor
2.	Dr. Shobha R. Prabhu	Asso. Professor / HoD
3.	Dr. Sathyajith	Asso. Professor
4.	Dr. Raghavendra Bairy	Asso. Professor
5.	Dr. Nagaraja B.S.	Asst. Professor Gd III
6.	Dr. Shyam Prasad . K.	Asst. Professor Gd III
7.	Dr. Saritha Suvarna	Asst. Professor Gd III
8.	Dr. Murari M S	Asst. Professor Gd III

DEPARTMENT OF CHEMISTRY

1.	Dr. Janardhana Nayak	Professor
2.	Dr. Ramesh Bhat	Asso. Professor
3.	Dr. Shivaprasad Shetty M.	Asso. Prof/HoD
4.	Dr. Santhosh Tiwari	Asso. Professor
5.	Dr. Aarti S. Bhat	Asst. Professor Gd III
6.	Dr. Subrahmanya Ishwar Bhat	Asst. Professor Gd III
7.	Dr. Sarvajith MS	Asst. Professor Gd III
8.	Dr. Ranjitha	Asst. Professor Gd III
9.	Dr. Shreya Kamath	Asst. Professor Gd III

DEPARTMENT OF HUMANITIES

1.	Dr. Ramakrishna B.	Professor
2.	Mrs. Rashmi D. Hegde	Asso. Professor
3.	Dr. Vishwanatha	Asso. Professor /HoD
4.	Dr. Jnaneshwar Pai Maroor	Asst. Professor Gd III
5.	Dr. Joy Elvine Martis	Asst. Professor Gd III
6.	Mrs. Shyla D Mendonca	Asst. Professor Gd II
7.	Ms. Sonia Lobo	Asst. Professor Gd I
8.	Ms. Akshatha Kumari J Shetty	Asst. Professor Gd I
9.	Mr. Srinivas Nekkar	Asst. Professor
10.	Mrs. Shwetha	Asst. Professor

OFFICE SECTION HEADS

1.	Mr. Keshava Mugeraya	Sr. Suptd, Academic Section/ Purchase In -Charge
2.	Mrs. Suneetha R. Shetty	Sr. Suptd, Administrative Section
3.	Mr. Suresh Achar	Sr. Suptd, Stores
4.	Mrs. Jayashree	Sr. Programmer, Office Automation Cell
5.	Mrs. Shailaja V. Shetty	Suptd, Accounts Section
6.	Dr. Preetham Shetty KV	Librarian

SECURITY DEPARTMENT

1.	Mr. Hirianna Suvarna S	Security Supervisor

SPORTS DEPARTMENT

1.	Sri. Shyam Sundar M.	P.E.D
2.	Sri. Ganesh Poojary	P.E.D
3.	Ms. Sowjanya M.	P.E.I
4.	Mr. Ravi Prakash C. Anpur	Basket Ball Coach
5.	Mr. Clive Nolan Mascarenhas	Football Coach
6.	Mr. Rajesh Acharya	Cricket Coach

HOSTEL WARDENS

1.	Dr. Veena Devi S.V	Chief Warden, NET Ladies Hostels, Nitte
2.	Dr. Vishwanatha	Chief Warden, NET Gents Hostels, Nitte

HOSTEL SUPERINTENDENT / MANAGER

1.	Mr. Manjunatha Suvarna	Hostel Manager, Gents Main Hostel
2.	Mr. Rajesh Ballal	Manager, Gents PG Hostel
3.	Mrs. Gayathri Kamath	Manager, Ladies PG Hostel
4.	Mrs. Chethana Sharma	Manager, Ladies Main Hostel
5.	Mrs. Hema S. Hegde	Superintendent, Hostel Office
6.	Mr. Kiran Kumar Annappa Kulal	Hostel Manager, Gents Main Hostel

REGULATIONS

2024-25

(Applicable for admission batch 2021-22 onwards)

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

CONTENTS

REGULATIONS

REGULATIONS COMMON TO ALL B.E. (CREDIT SYSTEM) DEGREE PROGRAMMES OF NMAM INSTITUTE OF TECHNOLOGY, NITTE Karkala, Udupi Dist., Karnataka

1. INTRODUCTION

1.1 The general regulations are common to all B.E. (Credit System) Degree Programmes conducted at the NMAMIT, Nitte Campus and shall be called "NMAMIT Regulations".

1.2 The provisions contained in this set of regulations govern the policies and procedures on the Registration of students, imparting Instructions of course, conduct of the examination and evaluation and certification of student's performance and all amendments related to the said Degree programme(s).

1.3 This set of Regulations, on approval by the Academic Council and Governing Council, shall supersede all the corresponding earlier sets of regulations of the BE Degree program (of VTU) along with all the amendments thereto, and shall be binding on all students undergoing the Graduate Degree Programme(s) (Credit System) conducted at the NMAMIT, Nitte with effect from its date of approval. **This set of Regulations, may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time, and shall be binding on all stake holders (The Students, Faculty, Staff of Departments of NMAMIT, Nitte). The decision of the Academic Council/ Governing Council shall be final and binding.**

1.4 In order to guarantee fairness and justice to the parties concerned in view of the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the appropriate authorities, as and when found necessary.

1.5 The Academic Council may consider any issues or matters of Concern relating to any or all the academic activities of NMAMIT courses for

appropriate action, irrespective of whether a reference is made here in this set of Regulations or otherwise.

1.6 The course shall be called **Bachelor of Engineering** course abbreviated as B.E. (Subject of specialization) – Credit System.

1.7 **DURATION OF THE COURSE**

(a) The course shall extend over a period of total duration of 4 years.

(b) Each year shall have the following schedule with **5** ½ days a week.

Suggested Break down of Academic Year into Semesters

1. No. of Semesters / Year	Three; Two being Main semesters (odd, even) and one being a supplementary semester; after 2 main semesters. (Note: Supplementary semester is primarily to assist weak and / or failed students through make up courses. However, Autonomous Colleges may use this semester to arrange Add-On courses for other students and / or for deputing them for practical training elsewhere.)
2. Semester Duration	Main semester (odd, even) each 19 Weeks; Supplementary Semester 8 Weeks
3. Academic Activities	Main Semester
(Weeks):	Registration of Courses & Course Work (16.0) Examination Preparation and Examination (3.0) Total (19) Supplementary Semester

	Registration of Courses & Course Work (5.0) Examination Preparation and Examination (3.0) Total (8) Declaration of results: 2 weeks from the date of last examination Inter- Semester Recess: After each Main Semester (2) Total Vacation: 10 weeks (for those who do not register for supplementary semester) and 4 weeks (for those who register for supplementary semester)

(Note: In each semester, there will be provision for students for Registration of courses at the beginning, dropping of courses in the middle and withdrawal from courses towards the end, under the advice of faculty member. These facilities are expected to enhance the learning capabilities of students, minimizing their chances of failure in courses registered and also ensure their better monitoring by Faculty Advisors).

A candidate shall be allowed a maximum duration of eight years from the first semester of admission to become eligible for the award of Bachelor Degree.

The calendar of events in respect of the course shall be fixed by the Senate from time to time, but preferably in line with the academic calendar of the VTU.

2. DEGREE PROGRAMMES

2.1 Undergraduate B.E. Degree Programmes are offered in the following disciplines by the respective programme hosting departments listed below:

i)	**Biotechnology Engineering**	**(BT)**
ii)	**Civil Engineering**	**(CV)**
iii)	**Computer Science & Engineering**	**(CS)**
iv)	**Electronics & Communications Engineering**	**(EC)**
v)	**Electrical & Electronics Engineering**	**(EE)**
vi)	**Information Science & Engineering**	**(IS)**
vii)	**Mechanical Engineering**	**(ME)**
viii)	**Artificial Intelligence and Machine Learning Engg.**	**(AM)**
ix)	**Computer and communication Engineering**	**(CC)**
x)	**Robotics and Artificial Intelligence Engineering**	**(RA)**

Other teaching departments are –

i)	**Mathematics**	**(MA)**
ii)	**Physics**	**(PH)**
iii)	**Chemistry**	**(CY)**
iv)	**Humanities, Social Sciences and Management**	**(HU)**

2.2 The provisions of these Regulations shall be applicable to any new discipline* that may be introduced from time to time and appended to the above list.

3. REGISTRATION

3.1 Every student after consulting his Faculty Advisor in parent department shall register approved courses (core and elective) to earn credits for meeting the requirements of degree program at the commencement of each Semester on the days fixed for such registration and notified in the academic calendar. Students who fail to register on or before the specified date will have to pay a late fee. Such courses together with their grade and credits earned will be included in the grade card issued by the college at the end of each semester, like odd, even, supplementary and it forms the basis for determining the student's performance in that semester.

3.2 Lower and Upper Limits for Course Credits Registered in a Semester Course Credit Assignment

All courses comprise of specific Lecture/Tutorial/Practical (L-T-P) schedule. The course credits are fixed based on the following norms.

Lecture / Tutorials / Practical:

i) One hour Lecture per week is assigned one Credit.

ii) 2-hour Tutorial session per week is assigned 1.0 Credit.

iii) 2-hour Lab. session per week is assigned 1.0 credit.

For example, a theory course with L-T-P schedule of 3-2-0 hours will be assigned 4.0 credits.

A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.

Calculation of Contact Hours / Week – A Typical Example

A student must register, as advised by Faculty Advisor, between a

minimum of 15 credits and up to a Maximum of 25 credits.

3.3 Mandatory Pre-Registration for higher semester

In order to facilitate proper planning of the academic activities of the Semester, it is necessary for the students to declare their intention to register for courses of higher semesters (3rd and above) at least two weeks before the end of the current semester choosing the courses offered by each department in the next higher semester which is displayed on the Department Notice Board at least 4 weeks prior to the last working day of the semester.

Registration to a higher semester is allowed only if the student fulfills the following conditions -

i) satisfied all the academic requirements to continue with the programme of studies without termination

ii) cleared all Institute, hostel and library dues and fines, if any, of the previous semester

iii) paid all required advance payments of the Institute and the hostel for the current semester

iv) has not been debarred from registering on any specific grounds by the Institute.

4. ADD / DROP / AUDIT options

4.1 Registration of courses

Each student shall have to register for course work at the beginning of a semester within 2 to 3 days of commencement after discussing with subject teacher and under faculty advice. The permissible course load to be either average credits (=20) or to be within the limits of minimum (=15) and maximum (=25) credits.

4.2 DROP-option

During a specified period at the middle of a semester student's performance in CIE is reviewed by the faculty advisor. Following poor performance by a student he/she can be facilitated to drop identified course(s) (up to the minimum credits specified for the semester). Such course(s) will not be mentioned in the Grade card. Such courses to be re-registered by these students and taken up for study at a later time.

4.3 Withdrawal from courses

During a specific period specified towards the end of the semester, student's performance in CIE is reviewed by the Faculty advisors. Following poor performance by a student in identified course (s) he/she is advised to

withdraw from such course(s) (up to the minimum credits specified for the semester) with mention in the Grade card (Grade 'W'). Such courses to be re-registered by these students and taken up for study at a later time.

4.4 AUDIT-option

A student can register for courses for audit only, with a view to supplement his/her knowledge and/or skills. The student's grades in such course(s) will have to be reflected in the grade card. However, CORE courses shall not be made available for audit. But these shall not be taken into account in determining the student's academic performance in the semester. 'U" grade is awarded to such courses on satisfying the attendance requirements and CIE requirements. The candidate need not appear for SEE in such courses.

5. COURSE STRUCTURE:

5.1 Typical Breakdown for the B.E. Degree Curriculum:

No.	Course Category	Credit Range
1.	Basic Science Courses	20-25
2.	Engineering Science Courses	18-22
3.	Humanity, Social Science and Management	8-12
4.	Ability Enhancement Courses	10-14
5.	Professional Core Courses (PCC)	40-45
6.	Professional Elective Courses (PEC)	8-12
7.	Open Elective Courses (OE)	8-12
8.	Skill Courses (Project Work / Internship / Seminar)	28-36
9.	Mandatory courses	2
Note: **Student can register between 15 to 25 credits per semester** **Total Credits to be earned : 160**		

5.2 The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the programme for the above

components, the semester wise distribution among them, as well as the syllabi of all undergraduate courses offered by the department from time to time before sending the same to the Board of Studies(BOS). The BOS will consider the proposals from the departments and make recommendations to the senate for consideration and approval.

5.3 **The earned Credit Requirement for the B.E. Degree is 160.**

Degree is awarded by prescribing the total number of credits to be earned, rather than by using the program duration, giving flexibility to student to plan their career.

5.4 **Mandatory Learning Courses**

These are courses that must be completed by the student at appropriate time or at his convenience. The 'PP' grade is awarded for a Pass in the course and 'NP' grade is awarded for a Fail in the course. In case 'NP' grade is awarded, the student has to re- register for the same course wherein he has no alternative options. However, he/she can opt for other courses if he/she has been provided with multiple options.

The 'PP' and 'NP' grades do not carry grade points and hence not included in the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) computations. However such non-credit mandatory courses are required to be included in the students' performance record (transcript) with Pass or Fail (PP or NP).

Courses that come under this category are the following.

Moral and Ethical Values, Communication skills, Entrepreneurship Development Programme, Environmental issues, Proficiency in a Language etc.

Such courses will not carry any credits for the award of degree, but a pass in each of such course during the programme shall be a necessary requirement for the student to qualify for degree award.

5.5 **PROJECT**

i) Project work at 7^{th} semester shall be completed batch wise. The batch shall consist of a maximum of 4 students.

ii) Project viva-voce examination shall be conducted individually.

5.6 **ELECTIVES**

i) A candidate shall take electives in each semester from groups of electives, commencing from 6^{th} semester.

ii) The minimum number of students to be registered for any Elective offered shall not be less than ten.

iii) A candidate shall opt for his/her choice of electives and register for the same if pre-registration is not done, at the beginning of each of 6^{th} & 7^{th} semesters. The candidate is permitted to opt for change of elective within 15 days from the date of commencement of the semester as per the academic calendar of the college.

6. ATTENDANCE REQUIREMENT:

6.1 Each semester is considered as a UNIT and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condoning 10% of the attendance by Principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops and paper presentation.

6.2 The basis for the calculation of the attendance shall be the period of term prescribed by the College by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course (as per CET/COMED-K or Management allotment).

6.3 The students shall be informed about their attendance position in the first week of every month by the College so that the students shall be cautioned to make up the shortage.

6.4 A candidate having shortage of attendance (<75%) in any course(s) registered shall not be allowed to appear for SEE of such course(s).Such students will be awarded 'N' grade in these courses.

He/she shall have to repeat those course(s). Such students shall re-register for the same course(s) core or elective, as the case may be when the particular course is offered next either in a main (odd/even) or supplementary semester.

6.5 **Attendance in CIE and SEE:** Attendance at all examinations both CIE and SEE of each course registered shall be compulsory and there shall not be any provision for re-examinations. Any student against whom any disciplinary action is pending shall not be permitted to attend any SEE in that semester.

7. WITHDRAWAL FROM THE PROGRAMME

7.1 Temporary Withdrawal

a) A student who has been admitted to a degree programme of the college may be permitted once during the course to withdraw temporarily, for a period of one semester, on the grounds of prolonged illness or grave calamity in the family etc., provided –

i) The student applies to the College within 6 weeks of the commencement of the college stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian.

ii) The College is satisfied about the genuineness of the case and that even by taking into account the expected period of withdrawal, the student has the possibility to complete the programme requirements (160 credits) within the time limits specified by the university.

iii) The student does not have any dues or demands at the College / University including tuition and other fees as well as library material.

iv) A student availing of temporary withdrawal shall be required to pay such fees and/or charges as may be fixed by the college until such time as his/her name appears on the Student's roll list. The fees/charges once paid shall not be refunded.

v) A student will be entitled to avail the temporary withdrawal facility only once during his/her studentship. However, any other concession for the concerned student shall have to be approved by the academic council.

7.2 Permanent Withdrawal

Any student who withdraws admission before the closing date of admission for the Academic Session is eligible for the refund of the deposits only. Fees once paid will not be refunded on any account.

Once the admission for the year is closed, the following conditions govern withdrawal of admissions.

(a) A student who wants to leave the College for good, will be permitted to do so (and take Transfer Certificate from the College, if needed), only after remitting the Tuition fees as applicable for all the remaining semesters and clearing all other dues if any.

(b) Those students who have received any scholarship, stipend or other forms of assistance from the College shall repay all such amounts.

(c) The decision of the Principal of the College regarding withdrawal of a student is final and binding.

8. EVALUATION SYSTEM

8.1 The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.

8.2 The Letter grades O, A+, A, B+, B, C, P, F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

8.3 The Letter grade awarded to a student in a course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to two mid- semester examinations and one semester end examination. The distribution of weightage among these components may be as follows.

Semester End Examination (SEE)	:	50% (50 marks)
Continuous Internal Evaluation (CIE)	:	50% (50 marks)
i) Quizzes, Tutorials, Assignments, Seminars, mini projects, tutorials etc.	:	10 marks
ii) Mid-semester Examination	:	40 marks

Any variation, other than the above distribution, requires the approval of the pertinent DUGC and Academic Council.

8.4 The letter grade awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DUGC and the performance in SEE held on specified period in a semester.

8.5 The course Instructor shall announce in the class and/or display at the Faculty door/website the details of the Evaluation Scheme, including the distribution of the weightage for each of the components and method of conversion from the raw scores to the letter-grades within the first week of the semester in which the course is offered, so that there are no ambiguities in communicating the same to all the students concerned.

8.6 Passing standards

Evaluation Method	Passing Standard
Sessional (CIE)	Score: ≥40% (≥20 marks)
Terminal (SEE)	Score: ≥40% (≥20 marks)

i) Project work evaluation: The evaluation of CIE of the project work shall be based on the progress of the student in the work assigned by the project supervisor, periodically evaluated by him/her together with a Department committee constituted for this purpose. Seminar presentation, project report and final oral examination conducted by project evaluation committee at the department level shall form the SEE of the project work.

ii) In the case of other requirements, such as, seminar, industrial internship, field work, comprehensive viva voce, if any, the assessment shall be made as laid down by the Academic council.

iii) **There shall be no re-examination for any course in the credit system.**

However, students

- who have abstained from attending CIE or SEE without valid reasons ('N' grade), or
- who have failed ('F' grade) to meet the minimum passing standards prescribed for CIE and/or SEE, or
- who have been detained for want of attendance, or
- who have withdrawn ('W' grade),
- who have dropped any course

shall be required to re-register for such course(s) and go through CIE and SEE again and obtain a grade equal to or better than E in each case. While such students should re-register for same course(s) if core, they can re-register for alternative course(s) from among the elective courses, as the case may be. The re- registration shall be possible when the particular course is offered again either in a main (Odd/Even) or a supplementary semester.

8.7

i) Absolute Grading – Letter Grade and its range

The grade point scale for absolute grading

Marks Range (%)	Grade Point	Letter Grade	Descriptor
90 & above	10	O	Outstanding
80-89	9	A+	Excellent
70-79	8	A	Very Good
60-69	7	B+	Good
55-59	6	B	Above Average
50-54	5	C	Average
40-49	4	P	Pass
00-39	0	F	Fails
Absent	0	AB	Absent

CGPA	Classification
7.00 & above	**First Class with Distinction**
6.00-6.99	**First Class**
5.00-5.99	**Second Class**
CGPA <5.00*	**Academic Probation / Non-compliance**

ii) The grade points given above help in the evaluation of credit points earned by the student in a course as the credit points are equal to the number of credits assigned to the course multiplied by the grade points awarded to the student in that course. This shall be used in arriving at the credit index of the student for that semester, as it is the sum total of all the credit points earned by the student for all the courses registered in that semester.

8.8 Earning of Credits

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 S-E. Letter grade 'F' in any course implies failure of the student in that course and no credits earned.

8.9 The Transitional Grades 'I', 'W' and 'X' would be awarded by the teachers in the following cases. These would be converted into one or the other of the letter grades (S-F) after the student completes the course requirements.

- Grade 'I': To a student having satisfactory attendance at classes and meeting the passing standard at CIE, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:

i) Illness or accident, which disabled him/her from attending SEE;
ii) A calamity in the family at the time of SEE, which required the student to be away from the College;

- Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Make up Examinations within 2 working days of that particular examination for which he or she is absent, failing which they will not be given permission. This is admissible only for students who have more than 45 CIE marks.
- Grade 'W': To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice
- Grade 'X': To a student having attendance ≥85% and CIE rating (90%), in a course but SEE performance observed to be poor, which could result in a F grade in the course. **(No 'F' grade awarded in this case but student's performance record maintained separately).**

8.10 Grade Card

Each student shall be issued a Grade Card at the end of each semester. This will have a list of all the courses registered by a student in the semester, together with their credits, the letter grades with grade points awarded. Only those courses registered for credit and having grade points shall be included in the computation of the students performance like SGPA and CGPA and the courses taken for audit will not form part of this computation. The results of mandatory courses, which are of the non-credit type shall also be reflected in the Grade card as PP (for Passed) or NP (for not passed). **Each UG student shall have to obtain the grade PP in each mandatory course to qualify for the Degree awarded by the university.**

8.11 The Make Up Examination

The Make Up Examination facility would be available to students who may have missed to attend the SEE of one or more course(s) in a semester for valid reasons and given the 'I' grade; Also, students having the 'X' grade shall be eligible to take advantage of this facility. The makeup examination would be held as per dates notified in the Academic Calendar. However, it would be possible to hold a makeup examination at any other time in the semester with the permission of the Academic Council of the College. In all these cases, the standard of makeup examinations shall be same as the regular SEE for the course(s).

a) All the 'I' and 'X' grades awarded to the students would be converted to appropriate letter grades after the make-up examinations. Any outstanding 'I' and 'X' grades after the last scheduled make-up examinations shall be automatically converted to 'F' grade.

b) All the 'W' grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/ supplementary semester and fulfill the passing standards for their CIE and (CIE+SEE).

9. EVALUATION OF PERFORMANCE

The overall performance of a student will be indicated by two indices: SGPA; which is the Semester Grade Point Average, and CGPA which is the Cumulative Grade Point Average.

SGPA for a semester is computed as follows.

$$\text{SGPA} = \frac{\sum [\textit{(course credit) X (Grade point)] (for all courses in that semester)}}{\sum [\textit{(course credits)}]}$$

CGPA is computed as follows:

$$\text{CGPA} = \frac{\sum [\textit{(course credits)X (Grade points)] (for all courses excluding those with F grades until that semester)}}{\sum \textit{(course credits)] (for all courses excluding those with F grades until that semester)}}$$

10. COMMUNICATION OF GRADES

The SGPA and CGPA respectively, facilitate the declaration of academic

performance of a student at the end of a semester and at the end of successive semesters. Both of them would be normally calculated to the second decimal position.

11. VERTICAL PROGRESSION (PROMOTION / ELIGIBILITY TO HIGHER SEMESTERS)

11.1 There shall be no restriction for promotion from an odd semester to the next even semester, provided the student has fulfilled the attendance requirement.

11.2 **A Student shall be declared fail if he / she**

(i) Has not satisfied the CIE requirements of any Course/s.

(ii) Has not registered for the SEE even after satisfying the attendance and CIE requirements.

11.3 **(A) Vertical Progression in case of students admitted to First year:**

(a) Students having not more than four F grades in the two semesters of first year of the Programme shall be eligible to move to second year.

(a.1) Students having not more than four F grades in the four semesters of I and II year shall be eligible to move to III year.

(a.2) Students who have earned all the prescribed credits of I year, and having not more than four grades in the four semesters of II and III year shall be eligible to move to IV year.

(B) Vertical Progression in case of Diploma students admitted to Second year (lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II) in the two semesters of II year of the Programme shall be eligible to move to III Year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The mandatory non-credit Courses Additional Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of B.E/B.Tech. Programmes shall attend the classes during the respective semesters to satisfy attendance and CIE requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the

Courses Additional Mathematics I and II, he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the Courses Additional Mathematics I and II shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Additional Mathematics I and II shall be mandatory for the award of degree.

(C) Vertical Progression in case of B.Sc students admitted to Second year (Lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme) in the two semesters of II year of the Programme shall be eligible to move to III year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The prescribed mandatory non-credit Courses Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme to lateral entry B. Sc holders admitted to III semester of B.E/B. Tech Programmes, shall attend the classes during the respective semesters to complete CIE and attendance requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the above said Courses; he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the above said Courses, shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics shall be mandatory for the award of degree.

The Principal of each college shall make suitable arrangements in the timetable to facilitate the B. Sc students to attend the above mentioned courses to satisfy the CIE and attendance requirements and to appear for the University examinations.

11.4 Termination from the programme

A student shall be required to withdraw (discontinue) from the programme and leave the college on the following grounds.

i) **Failure to secure a CGPA = 5.0 on three consecutive occasions.**
ii) **Failure to earn a credit of 160 (120 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).**
iii) Absence from classes for more than **six weeks at a time** in a semester without leave of absence being granted by competent authorities.
iv) Failure to meet the standards of discipline as prescribed by the college from time to time.

12. AWARD OF CLASS

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class. This can be seen from the following Table.

Percentage Equivalence of Grade Points (For a 10-Point Scale)

Grade Point	Percentage of Marks	Class
≥ 7.75	≥ 70%	Distinction
≥ 6.75	≥ 60%	First Class
< 6.75	< 60%	Second Class

Percentage = (GPA - 0.75) x 10

13. APPEAL FOR REVIEW OF GRADES

a. The entire process of evaluation shall be made transparent and the course instructor shall explain to a student why he/she gets

whatever grade he/she is awarded, if and when required. A mechanism for review of grade is incorporated in the evaluation system. However, before appealing for such review, a student shall first approach the concerned course Instructor and then the concerned DUGC, with the request to do the needful; and only in situations where satisfactory remedial measures have not been taken, the student may then appeal to the Department Academic Appeals Boards (DAAB) before the date specified in Academic Calendar, by paying the prescribed fees.

b. The fee for such an appeal will be decided by the Senate from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student.

14. AWARD OF DEGREE

14.1 (1) B.E. Degree

a) Students shall be declared to have completed the Programme of B.E./B.Tech. degree and is eligible for the award of degree, provided the students have undergone the stipulated Course work of all the semesters under the Scheme of Teaching and Examinations and has earned the prescribed number of credits (160 credits for regular students registered for 4 year degree programmes & 120 for lateral entry students).

b) For the award of degree, a CGPA≥5.00 at the end of Programme shall be mandatory.

c) Completion of Additional Mathematics I and II, shall be mandatory for the award of degree to lateral entry diploma students.

d) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme shall be mandatory for the award of degree to lateral entry B.Sc. graduates.

e) (i) Over and above the academic credits, every Day College regular student admitted to the 4 years Degree Programme and every student entering 4 years Degree Programme through lateral entry, shall earn 100 and 75 Activity Points respectively through AICTE Activity Point Programme for the award of degree. Students transferred from other Universities/Autonomous colleges under VTU to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eight semester Grade Card.

(ii) Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity Points before the commencement of 8th semester examinations, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

(2) B.E. (Honors) Degree

VTU, Belagavi has framed the guidelines for applying for the award of Bachelor of Engineering (Honors) degree.

These Regulations are applicable for the following students:

1. Admitted to **I semester** / I year from the academic year **2018-19** (i.e. USN XXX18XXXXX)
2. Admitted to **III semester** / II year from the academic year **2019-20** (i.e. USN XXX19XX4XX)
3. These Regulations are uniformly applicable to Affiliated, Autonomous and Constituent Colleges under VTU.

Eligibility criterion

(i) Students have to earn 18 or more additional credits through MOOCs.

(ii) Students shall register for this course from fifth semester onwards.

(iii) Students shall obtain a grade $\geq$ D in all the courses in first attempt only in all the semesters till 5th.

(iv) Students shall obtain CGPA of 8.5 and above at the end of fourth semester.

(v) For Diploma students, they shall complete Additional Mathematics I and II during 3rd and 4th semesters in first attempt only.

Requirements:

(i) Students shall maintain a grade ≥D in all courses from 5th to 8th semester in 'first attempt' only.

(ii) Students not having CGPA greater than or equal to 8.5 at the end of the B.E. programme shall not be eligible for the award of Honors degree, even if they have satisfied the requirement of additional credits.

(iii) Students shall take up additional course work, other than the regular courses prescribed by the University from 5th to 8th semester from NPTEL and other platforms notified by the University and complete the same in any number of attempts with a final score (online assignments: 25 % + Proctored examination: 75 %) leading to the following certificates – ELITE (60 to 75 %) or ELITE + SILVER (76 to 89 %) or ELITE + GOLD (≥ 90 %) before closure of eighth semester as per the academic calendar.

(iv) Students shall be permitted to drop the registered course work (s) and select alternative course work (s) in case they cannot give proctored examination.

(v) Students have to take courses from the list of MOOCs approved by the University, which can be from NPTEL / SWAYAM / other platforms.

(vi) Students shall select courses in consultation with their Class Advisor, such that the content / syllabus of them are not similar to that of the core courses, professional electives or open electives, which the students may chose in the program.

(vii) Students shall earn the additional credits for these courses through MOOCs, by only appearing in person to the proctored examinations conducted by NPTEL / SWAYAM / other platform. The method of assessment shall be as per NPTEL online platform.

(viii) The Credit equivalence shall be as follows - 4 weeks of online course duration – 1 credit, 8 weeks of online course duration – 2 credits and 12 weeks of online course duration – 3 credits.

Registration:

(i) Any student meeting the eligibility criteria and interested to register for Honors degree qualification shall apply to the University through the Principal in the prescribed form along with the prescribed application fees within 15 working days after notification by the University.

(ii) The Registrar shall notify the registration of the student and it will be notified to the student and the student shall pay a one-time, non-refundable registration fees as prescribed by the University to confirm the registration.

Award of Honors Qualification:

(i) Students who successfully complete the MOOCs prescribed by the University and submit their E-certificates to the University through the Principal against the notification issued by the Registrar in time before the closure of eighth semester, as per the academic calendar shall be eligible for B.E. (Honors) degree. If a student does not submit the certificates in time on or before the last date, their request shall not be considered, even if they have earned the requisite number of credits.

(ii) The Honors degree shall be awarded only if the CGPA at the end of the B.E. programme is equal to or greater than 8.5.

(iii) A student who has earned the requisite number of credits and who has submitted the certificates in time and has been accepted by the University will get B.E. degree with Honors suffixed indicating recognition of higher achievement by the student concerned.

(iv) Further students fulfilling all the above requirements shall be entitled to receive their transcripts indicating both the achievement of the student concerned.

(v) The award of the Honors degree shall be recommended by the Academic Senate and approved by the Executive Council of the University.

14.2 (1) Noncompliance of CGPA ≥ 5.00 at the end of the Programme

(a) Students, who have completed all the courses of the Programme but not having a CGPA ≥ 5.00 at the end of the Programme, shall not be eligible for the award of the degree.

(b) In the cases of 14.2 (1) a, students shall be permitted to appear again for SEE in course/s (other than Internship, Technical seminar, Project (Mini and Main), and Laboratories) of any Semester/s without the rejection of CIE marks for any number of times, subject to the provision of maximum duration of the Programme to make up the CGPA equal to or greater than 5.00 for the award of the Degree.

(c) In case, the students earn improved grade/s in all the reappeared course/s, the CGPA shall be calculated considering the improved grade/s. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(d) In case, the students earn improved grade/s in some course/s and the same or lesser than the previously earned pass grade/s in the other reappeared course/s, the CGPA shall be calculated considering the improved grade/s and

the pass grades earned before the reappearance. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA<5.00, the students shall follow the procedure laid in 14.2 (1) b

(e) In case, the students earn improved grade/s in some courses and fail in the other reappeared course/s, the CGPA shall be calculated by considering the improved grade/s and the previously earned pass grade/s of the reappeared course/s in which the students have failed. If it is≥5.00, the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(f) In case, the students fail (i.e., earns F grade) in all the reappeared course/s, pass grade/s of the course/s earned by the students before reappearance shall be retained. In such cases, the students shall follow the procedure laid in 14.2 (1) b

(g) Students shall obtain written permission from the Registrar (Evaluation) to reappear in SEE to make up the CGPA equal to or greater than 5.00.

(2) Noncompliance of Mini-project

(a) The mini-project shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the mini-project shall be declared fail in that course and shall have to complete the same during subsequent University examinations after satisfying the Mini-project requirements. Also, mini-project shall be considered for eligibility to VII semester.

(3) Noncompliance of Internship

(a) All the students of B.E/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation. A University examination shall be conducted during VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail in that Course and shall have to complete the same during subsequent University examinations after satisfy the internship requirements.

14.3 The maximum duration for a student for complying to the Degree requirements is 16 – semesters from the date of first registration for his first semester (8 years from the date of admission to first year, (12 semesters / 6 years from the date of admission for lateral entry student)).

15 GRADUATION REQUIREMENTS AND CONVOCATION

15.1 **A student shall be declared to be eligible for the award of the degree if he/she has**

a) **Fulfilled "Award of Degree" Requirements**
b) **No Dues to the College, Departments, Hostels, Library, Central Computer Centre and any other centres**
c) **No disciplinary action pending against him/her.**

15.2 **The award of the degree must be recommended by the Senate**

15.3 **Convocation**

Degree will be awarded for the students who have graduated during the preceding academic year. Students are required to apply for the Convocation along with the prescribed fees, after having satisfactorily completed all the degree requirements (refer 'Award of Degree') within the specified date in order to arrange for the award of the degree during convocation.

16 AWARD OF PRIZES, MEDALS, CLASS & RANKS

For the award of Prizes and Medals, the conditions stipulated by the Donor may be considered as per the statutes framed by the College for such awards.

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class as described in 12.

17 CONDUCT AND DISCIPLINE

17.1 Students shall conduct themselves within and outside the premises of the College in a manner befitting the students of an Institution of National Importance.

17.2 **As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.**

17.3 The following acts of omission/ or commission shall constitute gross

violation of the Code of Conduct and are liable to invoke disciplinary measures:

a) Ragging.
b) Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus.
c) Willful damage or stealthy removal of any property/belongings of the College/Hostel or of fellow students/citizens.
d) Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
e) Mutilation or unauthorized possession of Library books.
f) Noisy and unseemly behaviour, disturbing studies of fellow students.
g) Hacking in computer systems (such as entering into other Person's area without prior permission, manipulation and/or Damage of computer hardware and software or any other Cyber crime etc.).
h) Plagiarism of any nature.
i) Any other act of gross indiscipline as decided by the Senate from time to time.
j) Use of Mobile in the college Academic area.
k) Smoking in College Campus and supari chewing.
l) Unauthorized fund raising and promoting sales.

Commensurate with the gravity of offence the punishment may be: reprimand, expulsion from the hostel, debarring from an examination, disallowing the use of certain facilities of the College, rustication for a specified period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

17.4 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Dean (Academics), respectively, shall have the authority to reprimand or impose fine.

17.5 All cases involving punishment other than reprimand shall be reported to the Principal.

17.6 Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

18. EARNING OF ACTIVITY POINTS FOR THE AWARD OF DEGREE

18.1 As per VTU guidelines, every students entering 4 year degree programme should earn 100 activity points & every students entering 4 year degree programme through Lateral Entry should earn 75 activity points for the award of the Engineering Degree.

18.2 The Activity Points earned will be reflected on the student's eighth semester Grade Card.

18.3 The activities can be spread over the years (duration of the programme) any time during the semester weekends and holidays, as per the interest & convenience of the students from the year of entry to the programme.

18.4 Activity Points (non-credit) have no effect on SGPA/CGPA point.

18.5 In case students fail to earn the prescribed Activity Points, Eighth semester Grade Card shall be issued only after earning the required Activity Points.

Note: Students are required to be inside the examination hall 20 minutes before the commencement of examination. This is applicable for all examinations (Semester end/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

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LIST OF MAJOR SCHOLARSHIPS

Applicable to	*Types of scholarship*	*Method*	*Website*
For SC/ST Students	*Income : Below Rs.2,50,000/-*	*Online application*	**SSP**
	Income : Above Rs.2,50,000/- to Rs.10,00,000/-		
For Others	*Category I : Income Below Rs.2,50,000/-*	*Online application*	
	Category 2A, 3A, 3B Income Below Rs.1,00,000/-	*Online application*	
	GSB & Brahmins EWS Certificate upto Rs.8,00,000/-	*Online application*	
	Minority students Income Below Rs.2,50,000/-	*Online application*	*NSP & SSP*

Parents must have Beedi Id. Card	***Beedi Scholarship***	***Online application***	**scholarships.gov.in or nsp.gov.in**

1. **Scholarship details will be published in the notice board near College Academic Section. Students must see the notice board and submit the application before due dates.**

2. **All SC/ST and Category I students who have not paid any fee in CET must apply for Fee concession or Scholarship. Otherwise they must pay the tuition fee and college fee.**

3. **The students, who are applying for any of the above scholarship through online, must submit the hardcopy with supporting documents (with attestation) to the academic section in time.**

NMAM Institute of Technology, Nitte

An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi

B.E. in Civil Engineering

Scheme of Teaching and Examination 2023-24

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

B. E. SYLLABUS

CIVIL ENGINEERING

VII & VIII SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: CIVIL ENGINEERING

1.	Dr. I. Ramesh Mithanthaya	Ph. D	Prof./ Vice Principal /Dean(Aca)
2.	Dr. A.N. Parameswaran	Ph. D	Professor/ Director (III)
3.	Dr. Arun Kumar Bhat	Ph. D	Professor/HOD
4.	Dr. Srinath Shetty K.	Ph. D	Professor
5.	Dr. Bhojaraja B E.	Ph. D	Associate Professor
6.	Dr. Ranjith A	Ph. D	Associate Professor
7.	Dr. Shaik Kabeer Ahmed	Ph. D	Associate Professor
8.	Dr. Shriram P Marathe	Ph. D	Associate Professor
9.	Mr. J.K. Lokesh	M. Tech	Asst. Prof. Gd III
10.	Dr. Pushparaj A Naik	Ph. D	Asst. Prof. Gd III
11.	Dr. Mithun B.M.	Ph. D	Asst. Prof. Gd III
12.	Dr. Shanmukha Shetty	Ph. D	Asst. Prof. Gd III

13.	Mr. Manjunath M.	M.Tech. (Ph. D)	Asst. Prof. Gd III
14.	Mr. Sundip Shenoy R.	M.Tech. (Ph. D)	Asst. Prof. Gd II
15.	Mr. Gururaj Acharya	M. Tech.	Asst. Prof. Gd II
16.	Mr. Rakshith Kumar Shetty	M. Tech.	Asst. Prof. Gd II
17.	Mr. Roshan Rai	M. Tech.	Asst. Prof. Gd II
18.	Mr. Arjun K Punja	M. Tech	Asst. Prof. Gd II
19.	Mr. Thushar S. Shetty	M.Tech. (Ph. D)	Asst. Prof. Gd II
20.	Mr. Prashantha Kumar K.	M.Tech (Ph. D)	Asst. Prof. Gd I
21.	Mr. Prithviraj H.K.	M.Tech. (Ph. D)	Asst. Prof. Gd I
22.	Mr. Pradeep Karanth	M.Tech. (Ph. D)	Asst. Prof. Gd I
23.	Ms. Thanushree Hegde	M.Tech. (Ph. D)	Asst. Prof. Gd I
24.	Ms. Deekshitha M	M.Tech. (Ph. D)	Asst. Prof. Gd I

DEPARTMENT OF CIVIL ENGINEERING

Vision

To uphold the Department as a leader in commUNITy development through innovation and excellence in diverse areas of Civil Engineering to meet the global challenges and market demands.

Mission

1. To provide the students a strong theoretical knowledge and practical skills to understand the basic concept and fundamentals of various Civil Engineering subjects.
2. To be competent and skilled enough to take the challenges in Research, Consultancy and Entrepreneurship.
3. To encourage the students in developing professional ethics through discipline and principles.

Programme Educational Objectives (PEOs)

The graduates of the program will be

PEO1 Equipped with fundamentals of civil engineering along with interdisciplinary science, engineering and management concepts.

PEO2 Equipped with advanced and emerging field of civil engineering practices to compete and match with the industrial requirements.

PEO3 Competent enough to conceive the ideas, prepare plan, design, execute, monitor and manage the project with the effective utilization of resources such as men, material, machine and money along with time effectively.

PEO4 Continue to learn and adapt to suit the needs and challenges of real world problems and come up with optimal solutions.

Programme Outcomes (POs)

PO1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **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.

PO3 **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.

PO4	**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.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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	Ability to apply the knowledge of Civil Engineering domains, conduct experiments, analyze, interpret data and design the system components.
PSO2	Enrich the knowledge in Structural, Geo technical, Transportation, Environmental Engineering, Water Resources, Infrastructure and Development, Surveying and Geo-informatics by means of innovative practices.
PSO3	Competency to plan, produce detailed drawings, write specification, prepare cost estimates, selection of materials, schedule work plans, execute and value real properties.

VII SEMESTER B.E. / B. E Civil Engineering									
Sl. No.	Course and Course Code		Course Title	Name of teaching department	Teaching Hours / Week			Marks	Credits
					L	T	P/D	CIE+SEE	
1	PCC	21CV701	Quantity Surveying & Contract Management	Civil Engineering	3	0	0	50+50	3
2	PCC	21CV702	Hydrology & Irrigation Engineering	Civil Engineering	2	0	0	50+50	3
3	PEC	21CVXXX	Professional Elective-II	Civil Engineering	3	0	0	50+50	3
4	PEC	21CVXXX	Professional Elective-III	Civil Engineering	3	0	0	50+50	3
5	OEC	21XXXXX	Open Elective -II	Civil Engineering	3	0	0	50+50	3
6	Project	21CV703	Project Work	Civil Engineering	0	0	3	100+100	9
Note: BSC: Basic Science Course, PCC: Professional Core course, IPCC: Integrated Professional Courses, HSMC: Humanity, Social Science and Management course, INT: Internship, PE: Physical Education, UHV: Universal Human Values Courses.					Total Credits				24

QUANTITY ESTIMATION AND CONTRACT MANAGEMENT

Course Code:	21CV701	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Estimate the quantities of different items of work by using Centre line method and long wall- short wall method to know the approximate construction cost of buildings.
2.	Explain the specifications of Civil construction works.
3.	Find the quantities and able to calculate the rates of items.
4.	Outline the contract systems from the point of contractor's interest to avoid conflicts between client and contractors.
5.	Assess contract and tender documents for various construction work.

UNIT-I

16 Hours

ESTIMATES: Types, UNITs of measurements, abstract, cost of materials and labour.

BUILDING ESTIMATE: Methods of quantity extraction, cost of materials from Schedule of Rate (SR), preparation of detailed estimate for the load bearing structures using center line method and long wall-short wall method, preparation of detailed estimate of R.C.C structures.

UNIT-II

14 Hours

ESTIMATION OF: Manhole and septic tank.

SPECIFICATION: Objectives, essentials, general and detailed specification of common building items.

RATE ANALYSIS: Working out quantities and rates for earth work in different types of soils, P.C.C and R.C.C for different mixes, bricks and stone masonry, centering and form work for different RCC structural components flooring, plastering and painting.

UNIT-III

10 Hours

CONTRACT MANAGEMENT (Pre award): - Tendering Process: Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: Letter of intent, Award of contract, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD /NHAI). Law of Contract as per Indian Contract act 1872, Types of Contracts, Joint venture. Contract Forms: (source: PWD / CPWD /NHAI).
CONTRACT MANAGEMENT (Post award): Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach of contract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, Disputes and its resolution mechanism, Contract management and administration.

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

1.	Prepare a detailed estimate for load bearing and RCC structures.
2.	Estimate the rates for manhole and septic tank and write the general and detailed specification of common building items to the clients.
3.	Calculate the quantities and determine the rate of items.
4.	Outline the tender and contract documents for projects to avoid conflicts between client and contractors.
5.	Explain the tender and contract terminologies as applied to civil works.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	PSO↓ 2	
21CV701.1	1	1						1					2	1	3
21CV701.2	1	1								2			1	1	2
21CV701.3	2	1						1					1	1	3
21CV701.4	1					1		1		1			1	1	2
21CV701.5	1					1		1		1			1	1	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Dutta B.N. (2016) "Estimating & Coasting in Civil Engineering", UBS Publishers' Distributors Ltd, New Delhi.
2.	M. Chakraborti, (2010) "Estimating, Costing, specification and valuation in Civil Engineering." Published by author, Calcutta.
3.	B.S. Patil, (2015) "Civil Engineering Contracts and Estimates", Universities Press (India) Pvt. Ltd.

REFERENCE BOOKS:

1.	Rangwala S. C, (2014) "Estimating & specification", Charotar Publishing House Anand.
2.	Birde G.S, (2014) "Text book of Estimating & Costing", Dhanpath Rai and Sons, New Delhi.
3.	Martin Brook, (2008), "Estimating and Tendering for construction work", Butter worth- Heinemann Ltd, Oxford.
4.	Robert L Peurifoy, Garold D. Oberlender, (2015) " Estimating Construction Costs" , Tata McGraw-Hill Publishers , New Delhi.
5.	PWD Data Book, CPWD Schedule of Rates (SoR) and NH SoR – Karnataka FIDIC Contract forms.
6.	B.S. Ramaswamy, (2016), "Contracts and their Management", Lexis Nexis Publishers.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/105/103/105103093/

HYDROLOGY AND IRRIGATION ENGINEERING

Course Code:	21CV702	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	Explain hydrological cycle, water budget equation, determine mean rainfall and missing rainfall, distribution and its measurements.
2.	Analyze water losses like infiltration, evaporation and components of runoff.
3.	Explain systems and methods of irrigation, reference crop evapotranspiration and irrigation efficiencies.
4.	Distinguish canals, canal regulation works, cross drainage works and design irrigation channels using silt theories
5.	Analyse stability of gravity dams and explain types and failure of earthen dams.

UNIT-I

INTRODUCTION — **06 Hours**

Definition, importance of hydrology, global water availability, practical applications of hydrology, concept of catchment and water budget equation.

Forms and types of precipitation, measurement of rain fall - recording and non-recording type of rain gauges, computation of mean rainfall, moving average curve, return period - mass curve, rainfall hyetographs.

WATER LOSSES — **06 Hours**

Introduction, infiltration, factors affecting infiltration capacity, measurement (double ring infiltrometer), Horton's infiltration equation, infiltration indices. Evaporation- process, factors affecting evaporation, evapotranspiration, PET, AET, factors affecting ET, estimation of ET.

RUNOFF — **04 Hours**

Components - and factors affecting runoff, stream flow measurements- area velocity and slope area method, rainfall - runoff relationship- regression analysis, peak runoff (flood) estimation - rational method.

UNIT-II

IRRIGATION — **08 Hours**

Benefits and ill effects of irrigation, Water logging, need for drainage,

sources of water for irrigation, Systems and Methods of irrigation, Reference crop evapotranspiration - crop coefficients, crop water requirements, irrigation water requirements, irrigation efficiency, frequency of irrigation.

CANALS	**06Hours**

Types and - alignment of canals, design of irrigation channels for alluvial soils (only) using - Lacey's and Kennedy's methods, description of canal drops, canal regulators and cross drainage works

UNIT-III

RESERVOIRS	**04 Hours**

Types, investigation for reservoir sites, storage zones, determination of storage capacity and yield of a reservoir using mass inflow curve.

DAMS	**06 Hours**

GRAVITY DAMS: Forces acting, modes of failure, elementary and practical profile, stability analysis, single step design method.
EARTHEN DAMS: Types and modes of failure.

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

1.	Explain hydrological cycle, water budget equation and determine mean rainfall and missing rainfall.
2.	Determine water losses, stream flow and develop rainfall -runoff relationship applying regression analysis.
3.	Explain systems and methods of irrigation, reference crop evapotranspiration, crop and irrigation water requirements.
4.	Explain the alignment of canals, design irrigation channels applying Lacey's and Kennedy's theories and discuss canal drops, canal regulators and cross drainage works
5.	Find the storage capacity of reservoirs, analyze stability of gravity dams and explain the types and failures of earthen dams

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
													1	2	3
21CV702-1	1	3	1				2						2	3	
21CV702-2	1	3	1	1			2						2	3	
21CV702-3	1	3	1				2						2	3	1
21CV702-4	1	2	3				2						2	3	1
21CV702-5	1	3	3				2						2	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	K Subramanya , "Engineering Hydrology", Tata McGraw Hill, New Delhi, 4th Edition, 2017.
2.	Punmia B.C and PandeLal, "Irrigation and Water Power Engineering", Laxmi Publications, New Delhi, 16th edition, 2013

REFERENCE BOOKS:

1.	Garg S.K. "Irrigation Engineering and Hydraulic Structures: Water Resources Engineering, Vol. II" Khanna Publications, New Delhi, 5th edition 2016
2.	Modi P.N. "Irrigation, Water Resources, and Water Power Engineering", Standard Book House, New Delhi, 10th edition 2019
3.	Jayarami Reddy, "A Text Book of Hydrology", Lakshmi Publications, New Delhi, 2005
4.	Raghunath H. M. "Hydrology Principles, Analysis and Design", 3rd edition, New Age International, 2006.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/105/104/105104103/
2.	https://nptel.ac.in/courses/126/105/126105010/

Major PROJECT

Course Code:	**21CV703**	**Course Type:**	**Project**
Teaching Hours/Week (L: T: P: S):	**0:0:3:0**	**Credits:**	**9**
Total Teaching Hours:	**26**	**CIE + SEE Marks:**	**100+100**

Teaching Department: Civil Engineering

Course Objectives:

1.	Preparing a project - brief proposal including - Problem Identification
2.	Proposing different solutions for the problem based on literature survey
3.	List of possible solutions including alternatives and constraints
4.	A statement of system / process specifications proposed to be developed (Block Diagram/Flowchart)
5.	Developing a mathematical model for solving the above problem (if any)
6.	Finalization of system requirements and specification
7.	Consolidated report preparation of the above project as approved by the guide.

List of Experiments

1.	As per requirements
2.	
3.	
4.	

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

1.	Identify a project based on literature survey and evaluate probable issues concerning it.
2.	Formulate and present a plan for the problem solution with report.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CV703.1	3	2	3	2	2	2	2	2	3	2	3	2	3	2	3
21CV703.2	2	3	2	3	3	-	-	-	3	-	2	2	1	3	2

1: Low 2: Medium 3: High

VIII SEMESTER B.E. / B. Tech Civil Engineering									
Sl. No.	Course and Course Code		Course Title	Name of teaching department	Teaching Hours / Week			Marks	Credits
					L	T	P/D	CIE+SEE	
1	SEM	21CV801	Technical Seminar	Civil Engineering	3	0	0	100+0	1
2	INT	21INT81	Research/Industry Internship*	Civil Engineering	3	0	0	100+100	15
Note: BSC: Basic Science Course, PCC: Professional Core course, IPCC: Integrated Professional Courses, HSMC: Humanity, Social Science and Management course, INT: Internship, SEM: Seminar, UHV: Universal Human Values Courses.						Total Credits			16

TECHNICAL SEMINAR

Course Code:	**21CV801**	**Course Type:**	**Seminar**
Teaching Hours/Week (L: T: P: S):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**26**	**CIE + SEE Marks:**	**100+0**

Teaching Department: Civil Engineering

Course Objectives:

1.	Assess the quality of topic and interpret results.
2.	Present the topic using ICT skills and answer the queries.

List of Experiments

1.

1. Students has to search the topics from available literature or existing civil engineering projects which are recent and innovative in the field of construction. Select at least two or three topics and discuss with the Mentor and finalize one.
2. Prepare a detailed report highlighting the salient features and get it approved by the Mentor.
3. Prepare a power point presentation and present it in front of the Mentors and fellow students. There will be a discussion on the topic and the topic has to be defended by the student.

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

1.	Identify a research topic based on literature survey and evaluate probable issues concerning it.
2.	Formulate and present the selected topic with report.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CV801.1	3	2	3	2	2	2	2	2	3	2	3	2	3	2	3
21CV801.2	2	3	2	3	3	-	-	-	3	-	2	2	1	3	2

1: Low 2: Medium 3: High

Elective Groups

Elective Groups for 7th Semester B.E.

Professional Elective Course - 1 (Group 1)	
Course Code	**Course Title**
Stream – Structural Engineering	
21CVE101	Design of Masonry Structures
21CVE102	Matrix Methods of Structural Analysis
21CVE103	Structural Dynamics
21CVE104	Theory of Elasticity
21CVE105	Design of Prestressed Concrete Structures
Stream – Geotechnical and Transportation Engineering	
21CVE106	Earth Retaining Structures
21CVE107	Ground Improvement Techniques
21CVE108	Highway Geometric Design
21CVE109	Road Safety and Management
21CVE110	Traffic Engineering
Stream – Construction Technology and Management	
21CVE111	Advanced Concrete Technology
21CVE112	Alternative Building Materials and Technologies
21CVE113	Building Services
21CVE114	Construction Methods and Equipments
21CVE115	Construction Planning & Control
21CVE116	Construction Quality Management
Stream – Water Resources Engg, Environmental Engg. & Geology	
21CVE117	Advanced Hydraulics
21CVE118	Environmental Impact Assessment for Civil Engineering
21CVE119	Ground Water Hydrology &Exploration
21CVE120	RS & GIS application in Water Resource Engg.
21CVE121	Rural Water Supply & Sanitation
Stream – Software Oriented Courses in Civil Engineering Stream	
21CVE122	3D BIM - Autodesk Revit

21CVE123	CAD in Civil Engineering
21CVE124	Fundamentals of Machine Learning
21CVE125	GIS with Quantum GIS
21CVE126	Python Programming

Professional Elective Course - 2 (Group 2)	
Course Code	**Course Title**
Stream – Structural Engineering	
21CVE201	Earthquake Resistant Structures
21CVE202	Design of Bridges
21CVE203	Advanced RCC Design
21CVE204	Finite Element Method of Structural Analysis
21CVE205	Numerical Methods in Civil Engg
Stream – Geotechnical and Transportation Engineering	
21CVE206	Pavement Materials and Construction
21CVE207	Pavement Design
21CVE208	Reinforced Earth Structures
21CVE209	Deep Foundations
21CVE210	Environmental Geotechniques
Stream – Construction Technology and Management	
21CVE211	Design of Special Concretes
21CVE212	Sustainable Construction Materials and Methods
21CVE213	Valuation of Real Properties
21CVE214	Disaster Management and Mitigation
21CVE215	Construction Safety Management
21CVE216	Construction economics and finance
21CVE217	Finance Management
Stream – Water Resources Engg, Environmental Engg. & Geology	
21CVE218	Solid Waste Management
21CVE219	Advanced Applied Engineering Geology
21CVE220	Introduction to Geo-informatics

21CVE221	Geo-informatics in Environmental Engineering
21CVE222	Groundwater Recharge and conservation
Stream – Software Oriented Courses in Civil Engineering Stream	
21CVE223	Software Advances in Pavement Design
21CVE224	Application of RS&GIS for Water resources management
21CVE225	PROJECT PLANNING USING SOFTWARE
21CVE226	JAVA PROGRAMMING

Open Elective Course – 1 *(Offered by Civil Engg. Department to students of other programs)*	
Course Code	**Course Title**
21CV8X07	Environmental Impact Assessment
21CV8X67	Disaster Management
21HU8X71	Overview of Indian Culture and Arts
21CV8X96	Sustainability Engineering

Professional Elective Course - 1 (Group 1)

DESIGN OF MASONRY STRUCTURES			
Course Code	**21CVE101**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Know about 'Masonry', its use, advantages and disadvantages
2. Have clear knowledge of different types of 'Masonry UNITs', types and grades of 'Mortar' as per IS Code, properties of masonry UNITs and mortar.
3. Know the strength of masonry UNIT and masonry prism, computation of permissible strength of masonry for different types of masonry structures considering factors like 'Effective height',' Effective length', 'Slenderness ratio' and 'Eccentricity ratio'.
4. Design different types of masonry structures selecting suitable masonry UNITs and mortar using IS 1905 (revised in 2002) and SP 20.
5. Know about the use of (i) Reinforced Masonry, (ii) Composite Masonry (iii) Confined Masonry and (iv) 'In filled frames', their advantages and disadvantages.

UNIT – I

MASONRY UNITS, MATERIALS, TYPES & MASONRY CONSTRUCTION

Brick, stone and block masonry UNITs – strength, modulus of elasticity, water absorption and uses.

Mortar: classification and properties, selection.

Defects and errors in masonry construction cracks in masonry, types, reasons for cracking, methods of avoiding cracks.

Strength and Stability of concentrically loaded masonry walls, effect of UNIT strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship, strength formulae and mechanism of failure for masonry subjected to direct compression. **15 Hours**

UNIT – II

PERMISSIBLE STRESSES

Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses.

Load considerations for masonry: walls carrying axial load, eccentric load with different eccentric ratios—walls with openings and free-standing wall.

Design considerations: Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action and lintels. **15 Hours**

UNIT – III

Design of load bearing masonry walls for building up to 3storeys using IS 1905 and SP20 procedure.

Reinforced masonry and its application, flexural and compression elements of reinforced masonry, shear walls.

Composite masonry walls, composite wall beam elements, infilled frames.

10 Hours

Course Outcomes:

At the end of the course the student will be able to

1. **Explain** the types, properties, uses, defects, crack and its remedial measures in masonry structures)
2. **Analyze** the emerging permissible compressive, tensile and shear stress and factors influencing them for masonry elements.
3. **Explain** permissible stresses and design criteria as per IS: 1905 and SP-20.
4. **Determine** the effective height of walls, columns, effective length, effective thickness of wall and factors affecting them.
5. **Analyze and design** load bearing masonry walls for buildings up to three stories using IS: 1905 and SP-20 and **understand** the concept of reinforced masonry.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1										1	2	
CO 2	1	2	1										1	2	
CO 3	1	2	3										1	2	
CO 4	1	2	3										1	2	
CO 5	1	2	3										1	2	2

Note: 1: Low 2: Medium 3: High

TEXT BOOKS:

1. Henry A. W., (1990), "Structural masonry", Macmillan Education Ltd.
2. Dayarathnam P., (1987), "Brick and reinforced brick structures", Oxford & IBH Publication.
3. M. L. Gambhir, Building and Construction Materials (2017), Mc Graw Hill education Pvt. Ltd.

REFERENCE BOOKS:

1. Sinha, B.P and Davies, S.R (1997), "Design of Masonry Structures", E & FN spon.
2. IS 1905-1987 (3rd revision), "Code of practice for structural use of unreinforced masonry", BIS, New Delhi.
3. SP 20 (S& T) 1991, "Hand book on Masonry Design and Construction (1st revision)", BIS, New Delhi.
4. R E Klingner 2010 Masonry structural design, McGrawHill Companies, Inc. New York, pp 588.
5. National Building Code of India 2016 Vol.1, Part 6 Section 4 Structural Design – Masonry.

NPTEL SOURCE:

- https://nptel.ac.in/courses/105/106/105106197/

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MATRIX METHODS OF STRUCTURAL ANALYSIS			
Course Code	**21CVE102**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students:

(a) To **define** the flexibility and **development** of flexible matrix for defined coordinates for structural system.

(b) To **analyze** the trusses, continuous beams and rigid plane frames by flexibility matrix method.

(c) To **define** the stiffness and **development** of stiffness matrix for the defined coordinates for structural system.

(d) To **analyze** the trusses, continuous beams and rigid plane frames by stiffness matrix method.

(e) To **summarize** the direct stiffness method, local and global coordinates and **analyze** the trusses, continuous beams and rigid frames.

UNIT – I

Introduction to flexibility method, Element flexibility matrix, Principle of contragradience, and Force Transformation Matrix, Member Flexibility matrix, Construction of structure flexibility matrix. Matrix determination of the displacement vector, Determination of member forces*. Analysis of trusses by flexibility method using force transformation matrix.*

Analysis of axially rigid continuous beams and *rigid plane frames with axially rigid members by flexibility method using Force transformation Matrix*.

16 Hours

UNIT – II

Fundamentals of the stiffness method, equivalent joint loads, Displacement Transformation matrix. Member stiffness matrix, Total or System stiffness matrix, *Truss analysis by stiffness method using Displacement Transformation Matrix.*Continuous Beam and *rigid frame analysis with axially rigid members by stiffness method using displacement transformation matrix.*

15 Hours

UNIT –III

Introduction to direct stiffness method, local and global co-ordinate system, transformation of variables, transformation of the member displacement matrix, force matrix, stiffness matrix, transformation of the stiffness matrix of the member of a truss, transformation of the stiffness matrix of the member of the rigid frame, overall stiffness matrix, boundary conditions, computation of internal forces.

Analysis of pin jointed truss, rigid plane frames and continuous beams by direct stiffness method. **9 Hours**

NOTE:

1. Determination of member forces, displacement and reactions using matrices only
2. Number of indeterminacy shall be ≤ 3 (for paper setting)

Course Outcomes:

At the end of the course, students will be able to

1. **Define** flexibility matrix and **develop** flexibility matrix for assigned coordinates.
2. **Determine** the member forces in trusses, **analyze** continuous beams and rigid plane frames by flexibility matrix method.
3. **Define** stiffness matrix and **develop** stiffness matrix for assigned coordinates.
4. **Determine** the member forces in trusses, **analyze** continuous beams and rigid plane frames by stiffness matrix method
5. **Analyze** the trusses, continuous beams and rigid plane frames by direct stiffness method.

Mapping of POs & COs:

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

Note: 1: Low 2: Medium 3: High

TEXT BOOKS:

1. W. Weaver J.M. Gere, (1986), "Matrix Analysis of framed structures", CBS publishers and Distributors.
2. S Rajshekharan. G Sankara Subramanian, (2010), "Computational Structural Mechanics", PHI.

REFERENCE BOOKS:

1. L. S. Negi and R S Jangid, (1997), "Structural Analysis", Tata Mc Graw-Hill.

2. H C Martin, (1996), "Introduction to Matrix Methods of Structural Analysis", International Text Book Company.

3. R. Vaidyanathan, P.Perumal, (2007), "Comprehensive Structural Analysis– Volume I", Laxmi Publications (P) Limited.

4. S.S.Bhavikatti, (2013), "Matrix Methods of Structural Analysis", I.K. International Publishing House Pvt. Ltd.

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STRUCTURAL DYNAMICS

Course Code	**19CVE103**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. **Comprehend** principles of vibration and elementary components of a vibratory system.
2. **Comprehend** the behaviour of engineering structures subjected to dynamic forces.
3. **Analyze** undamped and damped free vibration of a single degree of freedom system
4. **Analyze** undamped and damped forced vibration of a single degree of freedom system
5. **Analyze** MDOF systems.

UNIT – I

Introduction to Structural Dynamics: Laws of motion, D'Alembert's Principle, Stiffness of springs in series and parallel, Mass moment of inertia, Simple harmonic motion, Vibration – Types, Parts of a vibrating system, *Degrees of freedom, Fundamentals of free vibration*.

Free vibration: Undamped and damped (single degree of freedom system), Logarithmic decrement. **15 Hours**

UNIT – II

Forced Vibration: Undamped and damped (single degree of freedom system) – Steady state response, Dynamic magnification factor, response to harmonic loading, Rotational and reciprocating unbalance, Force transmissibility, Force transferred to foundation, *Forced vibration and its effect on machine foundation.* **15 Hours**

UNIT – III

Multi Degree of Freedom (MDOF) Systems: Response to Free and forced vibration – natural frequencies, *determination of Eigen values and Eigen vectors* – Orthogonality principle, Shear buildings modeled as MDOF systems. Forced undamped and damped vibration of shear buildings – Modal superposition method. **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. **Explain** the principles of vibration and elementary components of a vibratory system.
2. **Discuss** the behavior of engineering structures subjected to dynamic forces.
3. **Analyze** undamped and damped free vibration of a single degree of freedom system.
4. **Analyze** undamped and damped forced vibration of a single degree of freedom system.
5. **Analyze** the given MDOF system.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	2		1									2	2	
CO 2	2	2		1									2	2	
CO 3	3	2		2									2	1	
CO 4	3	2		2									2	1	
CO 5	3	3		3									2	2	

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Text Books:

1. Mukhopadhya M. "Vibrations, Dynamics and Structural Systems" Oxford IBH Publications, 2000
2. Mario Paz. "Structural Dynamics" CBS Publishers, 2004

Reference Books:

1. Clough & Penzien. "Dynamics of Structures" McGraw Hill Publishers 2004
2. Anil K Chopra. "Dynamics of Structures" PHI Publishers 2006
3. S. R. Damodarasamy and S. Kavitha, Basics of Structural Dynamics and Aseismic Design, PHI Learning Private Limited, New Delhi, latest print 2015.

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THEORY OF ELASTICITY			
Course Code	**21CVE104**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

11. Understand the concept of plane stress and plane strain problems.
12. Develop compatibility equations for strains and strain measurements.
13. Formulate and solve two dimensional problems in case of bending and develop Airy's stress function equations
14. Derive compatibility equations in polar coordinates.
15. Analyze the stress distribution in axisymmetric problems and the effect of circular hole on the stress distribution.

UNIT – I

Introduction to elasticity :*stress and strain relations*, mathematical theory continuum, stress and strain at a point, constitutive laws, generalized Hooke's law, strain-displacement relations, stress tensor, stress transformation, stress invariants, strain tensor, strain invariants, plane stress and plane strain, principal stresses and strains.

Analysis of strain: F*ormation and solutions to differential equations*, measurement of surface strains – strain rosettes, compatibility concept – need and physical significance, compatibility equation in terms of strains.

15 Hours

UNIT – II

Two dimensional problems in Cartesian coordinates: compatibility equations for plane stress and plane strain cases, Airy's stress function – Polynomial stress functions. *Bending theory of beams- assumptions, bending stresses.* Bending of a cantilever beam subjected to end load and UDL, Sim ply supported beam subjected to UDL, Displacements in Cantilever and simply supported Beams.

Two dimensional problems in polar coordinates: Strain-displacement relations – Equations of equilibrium, Compatibility equation, Stress function.

15 Hours

UNIT – III

Axisymmetric Stress Distribution *stress - strain relations for thin and thick cylinders, radial and circumferential stress distribution,* Thick discs and cylinders, Rotating discs.

Circular Hole in a plate- Effect on Stress Distribution subjected to Tension, compression and shear, Stress concentration factor. **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. **Illustrate** mathematical representation of stresses, strains in continuum and **analyze** the beams for plane stress, plane strain conditions
2. **Formulate** compatibility equation in terms of strains and **measure** the strains in strain rosettes.
3. **Develop** the differential equations and **Solve** two dimensional problems in rectangular coordinates
4. **Develop** the differential equations and **Solve** two dimensional problems in polar coordinates.
5. **Determine** the stress distribution under axisymmetric loading in cylinders, rotating discs and **analyze** the effect of circular hole in a plate

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	2		1			2						2	2	
CO 2	2	2	2	1			2						2	2	
CO 3	3	2	3	2			2						2	1	
CO 4	3		2	2			2						2	1	
CO 5	2	2	2	2									2	2	

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. Timoshenko S.P. and Goodier J.N. "Theory of Elasticity", International Student's Edition, Mc Graw Hill Book Co., Inc., New Delhi,2005.
2. Wang P.C., "Applied Elasticity", 2005.

REFERENCE BOOKS:

1. Valliappan C., (1981), "Continuum Mechanics – Fundamentals", Oxford & IBH Publishing Co. Ltd, New Delhi.
2. Srinath L.S., (2009), "Advanced Mechanics of Solids", Tata Mc Graw Hill Publications Co. Ltd., New Delhi.
3. Venkataraman& Patel, "Structural Mechanics with introduction to Elasticity and Plasticity", Mc Graw Hill Book Inc., New York, 2009.
4. Dr. Sadhu Singh, 'Theory of Elasticity", Khanna Publishers, Delhi, 2009.
5. T. G. Seetharam & L. Govindaraju, "Applied Elasticity", Interline publishing.

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DESIGN OF PRESTRESSED CONCRETE STRUCTURES			
Course Code	**21CVE105**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. **Summarize** the concept, materials and types of pre-stressing.
2. **Analyse** the section for flexure and losses of pre-stress in concrete under different loading condition.
3. **Explain** deflection and analyse pre-stressed concrete members.
4. **Analyse** the section for flexure, shear in reference with IS code recommendations
5. **Solve** the permissible stress, Pre-stressing force and Eccentricity in a pre-tensioned and post-tensioned section.

UNIT–I

MATERIALS: High strength concrete and steel, stress-Strain characteristics and properties, Pre-tensioning and Post-tensioning systems, Tensioning methods and End Anchorages.

Basic principles of prestressing: Fundamentals, Load Balancing, Stress Concepts, Centre of Thrust.

ANALYSIS OF SECTIONS FOR FLEXURE: Stresses in concrete due to pre-stress and loads, Cable Profiles.

LOSSES OF PRE-STRESS: pre-tensioning and post tensioning, determination of jacking force. **15Hours**

UNIT–II

DEFLECTIONS: Short term and long-term, Methods of reducing deflection, Deflection limits as per IS: 1343, elastic deflections under transfer loads and due to different cable profiles, effect of creep, load verses deflection curve.

LIMIT STATE OF COLLAPSE: Flexural and Shear strength of sections, IS

Code recommendations, shear resistance of sections, shear reinforcement, limit state of serviceability – control of deflections and cracking.

16 Hours

UNIT–III

DESIGN OF BEAMS: pre-tensioned and post-tensioned symmetrical and asymmetrical sections. Permissible stress, prestressing force and eccentricity.

9**Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Summarize the concept, basic materials and types of pre-stressing systems.
2. Solve the stresses and losses in the pre-stressed members.
3. Explain Short-term and Long-term deflections and Evaluate the deflection under given loading condition
4. Analyze the section for flexure, shear under limit state of collapse and serviceability for pre-stressed concrete members.
5. Evaluate pre-tensioned and post tensioned beam components for permissible stress, Pre-stressing force and Eccentricity.

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. N. Krishna Raju, "Pre-stressed Concrete", 6th edition, Tata McGraw Hill Education (India) Pvt. Ltd, Chennai 2018.
2. Praveen Nagarajan, "Pre-stressed Concrete Design", Pearson Education, 2013

REFERENCE BOOKS:

1. T.Y. Lin and Ned H. Burns, "Design of pre-stressed concrete structures", 3rd edition, John Wiley & Sons, New York, 2015.
2. N.C. Sinha & S.K. Roy, "Fundamental of pre-stressed concrete", 2011, S. Chand Limited.
3. IS: 1343: 2012 "Pre-Stressed Concrete - Code of practice (To be provided in the examination)
4. P. Dayarathnam, "Pre-stressed Concrete", 6th edition, Oxford and IBH Publishing Co, 2018.
5. N. Rajgopalan, "Pre-stressed Concrete", Alpha Science International, 2005.

NPTELONLINESOURCE:
https://nptel.ac.in/courses/105/106/105106117/
http://www.nptelvideos.in/2012/11/prestressed-concrete-structures.html

EARTH RETAINING STRUCTURES			
Course Code	**21CVE106**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Know about types of retaining wall, forces acting on them and possible modes of failure of each type.
2. Understand how to analyze stability of different types of retaining wall, and to study different types of sheet pile walls and how to design them under different soil conditions.
3. Differentiate between cantilever sheet pile wall and anchored sheet pile wall with reference to the design and construction for given field conditions.
4. Study and understand lateral earth pressure distribution on sheeting of braced system in different soil types.
5. Study different components of braced systems, their selection and design them for given soil and depth of excavation. Also, to study the different types of coffer dams and the usefulness under the different situations.

UNIT – I

RETAINING WALLS: Types of retaining wall and forces on each type of wall. Modes of failure of retaining walls - sliding, overturning and bearing. Stability analysis and principles of the design of retaining walls – Gravity retaining walls, *Cantilever retaining walls, counter fort retaining walls (no structural design). Drainage from the backfill.*

BULK HEADS: Cantilever sheet pile walls *Types of sheet pile walls.* Cantilever sheet pile wall in cohesion-less soils. Cantilever sheet pile wall in clay. Design problem in each case. **16 Hours**

UNIT –II

BULK HEADS: Anchored Sheet Pile Walls:

Anchored sheet pile with free earth support in cohesion-less and cohesive soil. Bulkheads with fixed earth support method – *Types, locations and design of anchors*.

BRACED CUTS: Introduction. Lateral earth pressure on sheeting, Different types of sheeting and bracing systems. *Design of various components of bracings*. **15 Hours**

UNIT – III

COFFER DAMS & CELLULAR COFFER DAMS: Introduction. Introduction – *types of cofferdams*– safety against sliding, slipping, overturning, vertical shear and stability against bursting
Design of cellular coffer dam on soil -safety against sliding, slipping, overturning, vertical shear and stability against bursting. **9 Hours**

Course Outcomes:

At the end of the course students will be able to

1. **Explain** and **analyze** retaining wall, the force acting on earth type wall and possible mode of failure of each type.
2. **Explain** and **design** cantilever type sheet pile wall.
3. **Explain** anchored sheet pile walls, its advantage over cantilever sheet pile wall.
4. **Analyze** and identify lateral earth pressure distribution on sheeting of braced system for earth trench in different soil types.
5. **Analyze** and **design** coffer dams and cellular cofferdams.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2										2	3	1
CO 2	2	2	3										2	3	1
CO 3	1	2	3										2	3	1
CO 4	1	2	3										2	3	1
CO 5	2	2	3										2	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Clayton, C.R.I., Woods, R.I., Bond, A.J., Milititsky, J. – Earth Pressure and Earth-retaining structures, CRC Press, Taylor and Francis group, 2013
2. Budhu, M. – Foundations and Earth retaining structures, John Wiley & Sons, Inc., 2008

REFERENCE BOOKS:

1. Bowles, J.E. – Foundation Analysis and Design, 5th Edition, BBS Publisher, 2009.
2. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012.
3. Soil Mechanics and Foundation Engineering, Dr. K.R. Arora, (Sixth edition) (2003), Standard Publishers & Distributors.
4. Soil Mechanics and Foundation Engineering, S.K. Garg, (Fifth edition) (2004), Khanna Publishers.
5. Soil Mechanics and Foundation Engineering,: Dr. B.C. Punmia (2005), Laxmi Publications Ltd.,
6. Numericals in Geotechnical Engineering, A.V. Narasimha Rao & Dr. C. Venkataramaiah, University Press.
7. Soil Mechanics and Foundation Engineering, Dr. V.N.S. Murthy (2011), C B S Publishers and Distributers, Bengaluru.
8. Geotechnical Engineering, Dr. C. Venkataramaiah (2006), New Age publications.

NPTEL ONLINE SOURCES:

1. http://www.cdeep.iitb.ac.in/webpage_data/nptel/civil%20engineering/foundation_engineering/toc-m6.html
2. http://nptel.ac.in/courses/105106052/9
3. http://nptel.ac.in/downloads/105101083/

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GROUND IMPROVEMENT TECHNIQUES			
Course Code	**21CVE107**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Know the objectives of soil improvement, classification of ground improvement techniques and to select the best method or technique for the existing condition.
2. Know 'Hydraulic modification', its aim, principle and techniques such as gravity drain, lowering of water table, multistage well point, vacuum dewatering etc.
3. Define chemical modification, its aim, special effects, different methods or techniques.
4. Have a clear knowledge regarding "Grouting", effects of grouting, Chemicals and materials used, types of grouting. Grouting procedure and applications of grouting.
5. Know the concepts and use of recent methods in Soil reinforcement.

UNIT – I

GROUND IMPROVEMENT: Definition, Objectives of soil improvement. Classification of ground improvement techniques. *Factors to be considered in the selection of the best soil improvement* technique.

MECHANICAL MODIFICATION: Type of mechanical modification, compaction, Principle of modification for various types of soils. Effect of grain size distribution on compaction for various soil types like BC soil, lateritic soil, coarse-grained soil, micaceous soil. Effect of compaction on engineering behaviour like Compressibility, Swelling and Shrinkage, Permeability, relative density, liquefaction potential. *Field compaction - static, dynamic, impact and vibratory type*. Specification of compaction. Tolerance of compaction.

14 Hours

UNIT - II

HYDRAULIC MODIFICATION: Definition, aim, principle, techniques, gravity drain, lowering of water table, multistage well point, vacuum dewatering, design of dewatering system including pipe line *effects of dewatering*. Drainage of slopes, preloading, vertical drains, numerical problems on design of vertical drains, sand drains, Prefabricated vertical drains sand drains,

Electro osmotictic dewatering.

CHEMICAL MODIFICATION: Definition, aim, special effects, and methods, Techniques - sandwich technique, admixtures, cement stabilization. Hydration - effect of cement stabilization on permeability, Swelling and shrinkage. *Criteria for Lime stabilization, cement stabilization. - Suitability, process, special effects, criteria. Other chemicals, chlorides, hydroxides, lignin, hydrofluoric acid.* Fly ash in cement stabilization, Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization.

15 Hours

UNIT - III

GROUTING: Introduction, Effects of grouting, Chemicals and materials used, Types of grouting, Grouting procedure and Applications of grouting.

MISCELLANEOUS METHODS (only Concepts): Introduction, Soil reinforcement. Thermal methods*, Ground improvement by confinement - Crib walls, Gabions &Mattresses, Anchors, Rock bolts and soil nailing Geo-synthetics in soil modification, Micro piles. Case studies.* **11 Hours**

Course Outcomes:

At the end of the course, the student will be able to

1. **Understand** the objectives, necessity and scope of ground improvement techniques
2. **Identify** and implement the various methods of mechanical modifications in the soil improving techniques.
3. **Explain** the methods involved in ground modification by hydraulic methods.
4. **Identify** and apply the chemical modifications techniques in field conditions.
5. **Explain** techniques related to grouting and other miscellaneous soil reinforcement techniques.

Mapping of POs &COs:

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

CO 4	1	2			2	1	1					1	2	2	
CO 5	1	2			2	1	1					1	2	2	

Note: 1**:** Low 2: Medium 3: High

TEXT BOOKS:

1. Koerner. R.M. "Construction and Geotechnical Methods in Foundation Engineering", Prentice Hall, New Jersy, 3rd Edn. 2002.
2. Purushoptham Raj., P. "Ground Improvement Techniques" Tata McGraw Hill, New Delhi, 2005.

REFERENCE BOOKS:

3. Manfred Hausmann., "Engineering Principles of Ground modification". McGraw-Hill Ryerson, Limited, 1990
4. Colin, J.F.P. (1988) "Earth Reinforcement and Soil Structures".
5. Ingles, C.G. and Metcalf, J.B. (1956), Soil Stabilization- Principle and Practice.
6. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.

INTERNET SOURCES:

1. https://nptel.ac.in/courses/105/108/105108075/
2. http://www.cdeep.iitb.ac.in/webpage_data/nptel/civil%20engineering/foundation_engineering/course_home36.1.html

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HIGHWAY GEOMETRIC DESIGN			
Course Code	**21CVE108**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

At the end of the course the student will be able to:

1. Understand the different road design elements factors as per IRC Standards.
2. Acquire the knowledge in different cross-sectional elements of highway.
3. Understand and calculate the different sight distances, set back distance.
4. Understand the elements and calculate the length of horizontal and vertical alignment.
5. Identify different intersection and design the traffic rotary intersections and drainage systems.

UNIT – I

INTRODUCTION: *Objectives, requirements*, design control factors: topography, design speed, design vehicle, traffic capacity, volume, environment and other factors - IRC specifications, PCU concept for design.

CROSS SECTION ELEMENTS: Pavement surface characteristics –friction, skid resistance, pavement unevenness, light reflecting characteristics, camber: *objectives*, types, methods, pavement width carriageway, kerb, medians, shoulders, foot paths, parking lanes, service roads, cycle tracks, driveways, *guard rails, width of formation, right of way*, design of road humps as per IRC Specification. **15 Hours**

UNIT – II

SIGHT DISTANCES: Factors and problems: stopping and overtaking, at intersections, set back distances at curves.

HORIZONTAL AND VERTICAL ALIGNMENT: Horizontal alignment: *objectives, requirements*, design elements, super elevation, extra widening of pavements at curves, transition curve: types, evaluating length; vertical alignment*: gradient*, design criteria, types, design of summit and valley curves, design standards for hill roads. **15 Hours**

UNIT – III

INTERSECTION DESIGN: *Types*, elements, design considerations of at-grade intersection, grade separations and interchanges, rotary and its design only.

HIGHWAY DRAINAGE: *Importance, Requirements of surface and subsurface drainage*, design of cross sections and filter material. **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Explain the road design control factors as per IRC guidelines.
2. Explain the road surface characteristics, road side amenities and illustrate the design aspects of road hump as per IRC guidelines.
3. Determine the sight distances and set back distance at highway curves.
4. Design the horizontal, vertical alignment elements in highway and hill roads.
5. Illustrate the types of intersection, highway drainages and design traffic rotary, highway drainage cross section and filter material.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2										1	1	1
CO 2	2	2	2										1	2	1
CO 3	3	2	3										2	3	2
CO 4	3	2	2										1	2	2
CO 5	3	3	3										2	3	3

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Khanna S.K, C.E.G Justo & Veeraraghavan A. "Highway Engineering", Nemchand & Bros , Roorkee.(2014) (10th Revised Edition)
2. Kadiyali L. R., Lal. N.B, "Principles and Practices in Highway Engineering", Khanna Publishers, New Delhi. 7th Revised Edition. (2013).

REFERENCE BOOKS:

1. Sharma S K," Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd., New Delhi, 3rd Revised Edition. (2015).
2. Kadiyali, L. R., "Traffic Engineering and Transportation Planning", 7th Ed., Khanna publishers, India (2011).
3. Relevant IRC codes published by Bureau of Indian Standards, New Delhi.
4. Handbook for Roads and bridges – MORTH, New Delhi.(2001)

NPTEL ONLINE SOURCES:

- https://nptel.ac.in/courses/105/105/105105107/

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ROAD SAFETY AND MANAGEMENT			
Course Code	**21CVE109**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives

This Course will enable students to

1. Get awareness about the global, national and regional road crash scenario and their impacts
2. Identify the risk factors associated with crash involvement and its severity
3. Demonstrate the traffic management measures to minimize road crash
4. Understand the methods of collection and analysis of crash data
5. Gain the knowledge of the procedure for performing road safety audit.

UNIT – I

INTRODUCTION TO ROAD SAFETY ENGINEERING -

Over view of road safety - *Global road safety scenario and pattern - global trends and projections - national and state road safety level - problems in road safety in developing countries magnitude, socioeconomic and health effects.*

TRAFFIC ELEMENTS -

Characteristics of Road user, Motor vehicle, Roadway- relationship between elements- human factors governing road user behavior- risk factors for traffic accidents- exposure to risk- crash involvement- crash severity- post crash injury outcomes. **17 Hours**

UNIT-II

ANALYSIS AND PREVENTION OF ACCIDENTS

Collection of accident data- Statistical methods for analysis of accident data- Speed in relation of safety- Weather and its effects on accidents- *Vulnerable road users safety- parking influence on accidents.*

TRAFFIC MANAGEMENT MEASURES FOR ACCIDENT PREVENTION

Legislation, Enforcement, Education and Propaganda, *Formulating and implementing road safety policy.* **14 Hours**

UNIT-III

ROAD SAFETY IMPROVEMENT PROGRAM

Road safety audit (RSA) - Procedure in road safety audit- design standards- audit tasks- stages of road safety audit- key legal aspects. *Road design issues in RSA's – structuring and preparation of audit report.* **09 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. **Identify** the factors contributing to accidents
2. **Collect** the necessary data pertaining to road crashes and **prepare** comprehensive accident crash database.
3. **Perform** the statistical analysis of accident crash data.
4. **Describe** the traffic management measures for accident prevention
5. **Explain** the road safety audit and **prepare** a detailed audit report.

TEXT BOOKS:

1. Kadiyali, L. R., "Traffic Engineering and Transportation Planning", 7th Ed., Khanna publishers, India (2011).
2. David L. Geotsc. Occupational Safety and Health for Technologists, Engineers and Managers. 5th Edition, 2004.

REFERENCE BOOKS:

3. World Health Organization, Road Traffic Injury Prevention Training Manual, 2006.
4. Fuller, R., Santos, J.A. Human Factors for Highway Engineers, Pergamon, 2002.
5. IRC: 103-1988, Guidelines for Pedestrian Facilities, Indian Roads Congress, New Delhi.
6. IRC: SP: 32-1988, Road Safety for Children (5-12 Years old), Indian Roads Congress, New Delhi.
7. IRC: SP: 44-1996, Highway Safety Code, Indian Roads Congress, New Delhi.
8. IRC: SP: 88-2010, Road Safety Audit Manual, Indian Roads Congress, New Delhi.
9. Khanna. S. K, Justo. C.E.G, Veeraragavan. A, "Highway Engineering", Revised 10th edition, Nem Chand and Bros, 2014.
10. Sharma S K," Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd., New Delhi, 3rd Revised Edition. (2015).

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	3											2	1	
CO 2	3	1											1	2	2
CO 3	3	2	2										2		
CO 4	3	1												3	
CO 5	2	3												2	

1: Low 2: Medium 3: High

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TRAFFIC ENGINEERING			
Course Code	**21CVE110**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives

At the end of the course the successful student will be able to:

1. Understand the fundamentals of traffic engineering, scope and its uses in the actual field condition.
2. Understand the significance of various traffic studies as per IRC guidelines.
3. Understand the flow theories and its probabilistic approach in connection with traffic engineering.
4. Acquire the knowledge of traffic signals design and other traffic regulatory methods as per IRC.
5. Impart the basic knowledge on traffic rotary, street lighting, arboriculture and intelligent transport system.

UNIT- I

Introduction to Traffic Engineering: *Scope*, road user and vehicle characteristics- static and dynamic, *reaction time of driver*.

Traffic parameter Studies and Analysis: *Objectives*, method of study-definition, data collection and analysis(traffic volume, spot speed, origin and destination, speed and delay), parking- on street and off street parking, accidents- *causes*, analysis and *measures.* **16 Hours**

UNIT –II

Traffic Flow Theories: Green shield theory, Goodness of fit-correlation and regression analysis (linear only), Queuing theory, car following theory, Traffic forecast- simulation technique.

Traffic Regulation and Control: *Controls-Driver, Vehicle and Road*, Traffic Regulations- One Way Streets, *Traffic Signs*, *Road Markings*, Traffic signals-types, design principles (Webster's and IRC Method). **15 Hours**

UNIT –III

ROAD INTERSECTIONS AND MANAGEMENT: Road intersection**-** Importance, classification, Rotary design, *Highway lighting, Road side Arboriculture*, Intelligent Transport system. **9 Hours**

Course Outcomes:

At the end of the course the student will be able to:

1. Explain the Scope and characteristics of traffic engineering.
2. Illustrate the importance and methods in Traffic studies.
3. Summarize the Traffic flow theories and explain the importance.

4. Apply the design principles of traffic signals and outline the traffic regulation measures.
5. Design the rotary intersection and explain the importance of highway lighting, arboriculture and ITS.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1				1	1						2	1	
CO 2	2	3	2			1	1						3	2	
CO 3	3	2				1	1						2	1	
CO 4	2	2	3			1	1						2	2	1
CO 5	3	2	3			1	1						2	2	2

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Khanna S.K, C.E.G Justo & Veeraraghavan A. "Highway Engineering", Nemchand & Bros, Roorkee. (2014) (10th Revised Edition)
2. Kadiyali, L. R., "Traffic Engineering and Transportation Planning", 7th Ed., Khanna publishers, India (2012).

REFERENCE BOOKS:

1. Sharma S K," Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd., New Delhi, 3rd Revised Edition. (2015).
2. Kadiyali L. R., Lal. N.B, "Principles and Practices in Highway Engineering", Khanna Publishers, New Delhi. 7th Revised Edition. (2013).
3. Fred L. Mannering, Scott S. Washburn and Walter P. Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt Ltd, New Delhi. (2011)
4. Relevant IRC codes published by Bureau of Indian Standards, New Delhi.
5. Handbook for Roads and bridges – MORTH, New Delhi.(2009)

NPTEL SOURCES:

- https://nptel.ac.in/courses/105/105/105105107/

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ADVANCED CONCRETE TECHNOLOGY			
Course Code	**21CVE111**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives

This Course will enable students to:

1. Understand the importance of microstructure of cement and concrete, types of admixtures and its properties in fresh and hardened state of concrete.
2. Know the tests and factors affecting the results of hardened concrete.
3. Understand durability requirements.
4. Select a suitable type of concrete based on specific application.
5. Know the design concepts cement concrete by BIS method.

UNIT- I

INTRODUCTION: Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, Transition Zone, transport through cement microstructure. Rheology of concrete.

TESTS ON HARDENED CONCRETE: Elastic Modulus, factors affecting strength and elasticity of concrete, Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition. Determination of hardened concrete original W/C. NDT test concepts - Rebound hammer, Ultrasonic Pulse Velocity (UPV) methods. **16 Hours**

UNIT –II

DURABILITY OF CONCRETE -

Effect of fire, aggregates, abrasion and cavitation. Autogenious, drying and plastic cracking in concrete.

Corrosion of steel reinforcement, carbonation, chloride ingress, corrosion of prestressing steel. Sulphate attack and delayed ettringite formation, physical salt attack.

SPECIAL CONCRETES

Concept, materials, properties and applications of Alkali Activated Binders, Graphic concrete pattern for precast concrete surface, Self-healing concrete, Pollution Eating Concrete, Engineered Cementitios Composites, Bio Receptive Concrete to colonize structural concrete, Living 'concrete' to reduce the environmental impact, High quality Graphene concrete, Cement made with CARROT extract. **15 Hours**

UNIT-III

MIX DESIGN - Factors affecting mix design, Design of High Strength Concrete mixes with/without mineral admixtures using IS 10262-2019 method.

8 Hours

Course Outcomes:

At the end of the course the student will be able to:

1. **Explain** the microstructure of HCP, mechanism of Water Reducing Agents, Bingham's parameters, elasticity of concrete, **calculate** the effect of chemical composition changes on Bogue's compounds formation and effect of w/c on Volume and porosity.
2. **Explain** the effect of admixtures on fresh and hardened concrete properties, **compare** the effects of test conditions on concrete strength.
3. **Explain** the durability of concrete and **identify** the remedial measures for the durability related issues.
4. **Explain** the concept, materials, properties, applications, manufacturing method and typical mix of special concretes.
5. **Design** High Strength Concrete mix proportioning with/without mineral admixtures, as per IS 10262-2019.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	1											1	2	
CO 2	2	1					1						1	2	2
CO 3	2	1	1			1							1	2	1
CO 4	2	1					1						2	2	2
CO 5	3	2	3			1	1	2					2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. Neville, A.M., "**Properties of Concrete",** ELBS Edition, Longman Ltd., London. 2015.
2. M.S. Shetty, (2015) "**Concrete Technology Theory and Practice" S. chand and company New Delhi.**
3. P.K. Mehta, P J M Monteiro, (2016) "**Concrete microstructure and properties",** Prentice Hall, New Jersey (Special Student Edition by Indian Concrete Institute, Chennai).

REFERENCE BOOKS:

1. IS 10262-2019 "Concrete mix proportioning guidelines".
2. N. Krishna Raju, "**Concrete Mix Design",** Sehgal Publishers, 2016
3. Gambhir M.L, "**Concrete Manual**", Dhanpat Rai & Sons, New Delhi, 2012

NPTEL:

https://nptel.ac.in/courses/105/106/105106176/

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ALTERNATIVE BUILDING MATERIALS & TECHNOLOGIES			
Course Code	**21CVE112**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. **Learn** the energy consumption in building materials and cost effective technologies in buildings.
2. **Illustrate** the design concept for green building taking into consideration of local climatic condition and building materials.
3. **Summarize** the alternative building materials in the present context from wastes.
4. **Summarize** the alternative building technologies which are followed in present construction.
5. **Outline** alternate roofing systems with respect to local climatic conditions and locally available building material

UNIT – I

INTRODUCTION

Energy in building materials, Environmental issues concerned to building materials, embodied energy calculations. Green design concepts in buildings and its rating, Rainwater harvesting. Environmental friendly and cost effective building technologies, Cost concepts in buildings, Cost saving techniques in planning, design and construction.

Comprehensive understanding, criterion, rating procedure of green building through GRIHA assessment. **14 Hours**

UNIT – II

ALTERNATIVE BUILDING MATERIALS - Fiber reinforced concrete - Matrix materials, metal and synthetic fibers, Properties and applications. Ferrocement components, materials and specifications, properties and construction methods. Masonry blocks using industrial wastes, Raw materials, manufacture, properties, advantages and disadvantages of FaL G blocks and Stabilized mudblock.

Building materials from agro and industrial wastes Types of agro wastes, Types of industrial and mining wastes, properties and applications. **15 Hours**

UNIT – III

ALTERNATIVE BUILDING TECHNOLOGIES

Use of arches in foundation, alternatives for wall construction, composite masonry, confined masonry, cavity walls, rammed earth, applications, Top down construction.

Alternative roofing systems: concepts of filler slabs, composite beam panel roofs. Waffle slab construction. Bridge construction by balanced cantilever, incremental launching methods.

Mivan Construction Techniques, Precast concrete and modular construction methods.

10 Hours

Course Outcomes:

At the end of the course the student will be able to

1. Solve the problems related to Energy of building materials and make use of cost effective building technologies.
2. Make use of the design concept for green building taking into consideration of local climatic condition and building materials.
3. Utilize suitable agro and industrial wastes as a building material.
4. Select suitable type of alternative building technologies used in civil engineering construction.
5. Make use of the alternative economical roofing system by considering local climatic condition.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2														3
CO 2	1														2
CO 3	2	1											2		2
CO 4	2	1											2	2	3
CO 5	2												2	2	3

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. K.S Jagadish et al., "Alternative Building Materials and Technologies", New Age International Publishers – 1st edition -2007, Reprint: Aug – 2014

2. Arnold W Hendry, "Structural Masonry", Macmillan Publishers 3rd Edition December 2013.

REFERENCE BOOKS:

1. IS: 15912 (first revision 2017) Structural Design Using Bamboo – Code of Practice.

2. James J Marks, "The Alternative Building Source Book", Chelsea Green Publishers, 1st Edition 1998.

3. Clarke Snell et al., "Building Green", Large Book Publishers, 1st edition in 2005, reprinted -2014.

4. Jon Nunan, "The Complete Guide to Alternative Home Building Materials and Methods", Atlantic Publishing Company 30th October – 2009, Re-Print 2010.

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BUILDING SERVICES			
Course Code	**21CVE113**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students

1. To gain the knowledge of different building services and their types used in buildings.
2. To understand the functional requirements of ventilation and principles of illumination of buildings.
3. To outline the classification of air conditioning based on function and season.
4. To gain knowledge of different thermal properties and insulation materials for buildings.
5. To explain the fire hazards and general safety requirements for buildings.

UNIT – I

Introduction: requirements and necessity of services for buildings. Types.
Ventilation: Definition, Necessity, Functional Requirements, Types- Natural Ventilation and Artificial Ventilation
Illumination of buildings- definition, laws of illumination, principles, artificial lighting, day lighting, flood lighting, Introduction to various types of lamps. **15 Hours**

UNIT – II

Air conditioning of buildings- essentials of air-conditioning systems, classification based on function & season, systems, design- AC load calculations, installation and maintenance cost.
Thermal comfort in buildings- factors affecting, heat transfer through buildings, thermal properties of building materials, insulation materials for buildings. **15 Hours**

UNIT – III

Fire protection: necessity, fire hazards, characteristics and types of fire-resistant materials, fire load and its calculation, fire resistant construction – walls and columns, floors and roofs, wall openings, escape elements and strong room construction, fire protection equipment. General fire safety requirements. **09 Hours**

Course Out comes:

At the end of the course the student will be able to

1) **Explain** the different building services and their types used in buildings.
2) **Summarize** the functional requirements of ventilation and principles of illumination of buildings.
3) **Classify** the air conditioning based on function and season.
4) **Explain** thermal properties and insulation materials for buildings.
5) **Explain** the fire hazards, **assess** fire load and **summarize** the general safety requirements for buildings.

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS

1. Building construction by B.C.Punmia, Laxmi Publications.
2. A Text Book on Building Construction by P.C.Varghese, Prentice Hall of India publications
3. Architectural Lighting by Bran David.

REFERENCE BOOKS

1. IS SP41and SP32-hand book on functional requirements of buildings

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CONSTRUCTION METHODS AND EQUIPMENT			
Course Code	**21CVE114**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Summarize the construction of equipment planning, cost of owning and operating.
2. Explain the types and specifications of compacting equipment's.
3. Outline the fundamentals and preliminary earth work operations.
4. Explain the types, basic parts and operating procedure of earthwork equipment's.
5. Outline the process of foundation grouting.

UNIT – I

Construction planning, types, importance, lack of planning. Equipment management in projects, classification of equipment's, selection of construction equipment's, *cost of owning and operating, economic life of equipment's, cost control of equipment's, depreciation analysis.*

Equipment for Compaction – Introduction, specification and types of compacting equipment's. **15 Hours**

UNIT – II

Equipment for Earthwork - Fundamentals of Earth Work Operations, types of Earth Work, Machines for preliminary work.

Tractors – Basic parts and operation, Scrapers – types, construction, operation and applications, Motor Graders – construction, operation and safety, Dragline – types, basic parts and operation. Clamshells – Classification, Hoe – basic parts, operation and application, Bulldozer – Classification, selection of type of bulldozer and out of bulldozer. Power Shovel – *types, basic parts, operation of shovel, selection of type, size of power shovel and factors affecting the output of power shovel, methods of improving the output of power shovel*. **15 Hours**

UNIT – III

Foundation grouting – materials, purpose, exploring the need, *rate of grouting, equipment's of cement grouting and effectiveness.* **10 Hours**

Course Out comes:

At the end of the course the student will be able to

1) **Explain** the planning of construction equipment and **solve** for the owning, operating and depreciation cost.
2) **Summarize** the types and specifications of compacting equipment's.
3) **Explain** the fundamentals and preliminary earthwork operations.
4) **Explain** the types, basic parts and operating procedure of earthwork equipment's and **calculate** the output of a power shovel.
5) **Summarize** the process of foundation grouting.

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS

1. B. Satyanarayana and S. C. Saxena, "Construction, Planning and Equipment's", Standard Publishers New Delhi, 8th edition, 2019.
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction. Planning, Equipment and Methods", 9th Edition, McGraw Hill, Singapore, 2019.

REFERENCE BOOKS

1. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 2017
2. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.
3. Dr. Mahesh Varma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi, 1983.

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CONSTRUCTION PLANNING AND CONTROL			
Course Code	**21CVE115**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

At the end of the course the students will be able to:

1. Illustrate concepts related to management, economics and project feasibility conditions.
2. Outline the principles and concepts involved in management.
3. Illustrate the needs of planning and updating project schedule through project management tools such as CPM, PERT.
4. Identify suitable database to manage and organize information's in project.
5. Solve problems using optimization techniques.

UNIT - I

ENGINEERING ECONOMICS- Basic Concepts of economic analysis, Micro and Macro analysis, project feasibility, benefit cost ratio, interest formula, present worth, future worth, Annual equivalent, Basis for comparison of alternatives, break even analysis. Introduction to management, organization and administration.
Value engineering, time management, labor and Material management.

16 Hours

UNIT – II

CONSTRUCTION PLANNING - Introduction, time estimates, planning methods of projects, Bar and Milestone charts, PERT and CPM network analysis, crashing of networks.
Project Information and its accuracy, use of Information, organizing information in databases, Relational and conceptual model of databases, Centralized database management Systems, Programs, Information Transfer and Flow.
Computerized Organization and use of Information. **14 Hours**

UNIT - III

OPTIMIZATION TECHNIQUES: Linear Programming: standard form of

linear programming, formulation, solution to LPP by graphical method.
Transportation Problem: Introduction, mathematical formulation, methods for initial basic feasible solution, North West corner method, Vogels Approximation method.
Transportation Problem: least cost method, Row and Column minima method.

10 Hours

Course Outcomes:

At the end of the course the students will be able to:

1. Make use of concepts related to management and economics for project feasibility.
2. Relate effectively the principles and concepts involved in management of civil works.
3. Utilize project management tools to develop plan and schedule.
4. Identify and choose database systems to manage and organize systems.
5. Utilize the linear programming and transportation problems for solutions.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2														3
CO 2		1									1				
CO 3	2										2		2		3
CO 4	2	1									1				
CO 5	2										2				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. K. Subramanyam, "Construction Management", Anuradha Publishers Madras, (2009).
2. L.S. Srinath, "Pert and CPM". Affiliated East-West Press Pvt. Ltd. New Delhi. (2014).
3. B.C Punmia, "Pert and CPM", Lakshmi publication (2016).

4. Peurifoy , R.L , "Construction Planning equipments and methods", 8th edition, Mc Graw Hill Publication (2010).

REFERENCE BOOKS:

19. Mahesh Varma, "Construction planning and management", Metropolitan Book Co, Delhi.
20. S.D. Sharma, "Operation research". 4th edition, Pub: KedarnathRamnath, Meerut, Delhi (2015).

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CONSTRUCTION QUALITY MANAGEMENT			
Course Code	**21CVE116**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1) Summarize the history and quality elements in engineering management.
2) Explain the Integrated quality management as per International Organisations for Standardization.
3) Utilize the quality control in construction projects.
4) Summarize the process and steps involved in benchmarking process.
5) Outline the quality management system in construction projects.

UNIT – I

Quality –History, definition, inspection, control, assurance, engineering, management, Quality guru's, quality function deployment, *six sigma methodology – leadership principles, six sigma team.*
Integrated Quality Management – quality standards, International Organisations for standardization (ISO), ISO 9000 Quality Management system, ISO Certification, ISO 14000 Environmental Management System, *Occupational Health and safety assessment series.* **15 Hours**

UNIT - II

QUALITY CONTROL IN CONSTRUCTION PROJECTS QC in concreting, Brick work, stone masonry, Formwork, Foundations, Piling work, Structural work, Woodwork & Timber, Painting, Electrical system, *Waste recovery and maintenance.*
BENCH MARKING: Sources, Process & Step model for Benchmarking, Types of Benchmarking and Code of Conduct. *Internal & External Benchmarking, Advantages of Benchmarking.* **15 Hours**

UNIT – III

QUALITY MANAGEMENT SYSTEM IN CONSTRUCTION PROJECTS: Concept, Approach to Problems, Quality Assurance, Quality Control, *Quality Inspection, Records and Reports, Training*, Total Quality Control, Manual/Check Lists, Guide Lines. **10 Hours**

Course Out comes:

At the end of the course the student will be able to

1) **Explain** the history, quality elements and **summarize** the six-sigma methodology.
2) **Summarize** the Integrated quality management as per International Organisations for Standardization.
3) **Explain** the quality control carried in the construction projects.
4) **Explain** the process and steps involved in benchmarking process.
5) **Explain** the quality management system in construction projects.

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS

1. Total Quality Management for Engineers by Mohammed Zairi, Aditya Books Pvt. Ltd., New Delhi. 1992.
2. Project Planning and Control with PERT and CPM by B.C. Punmia and K.K. Khandelwal, Lakshmi Publications Pvt. Ltd., New Delhi.
3. Total Quality Management by B. Janakiraman and R.K. Goapal, Prentice-Hall of India Private Limited, New Delhi.

REFERENCE BOOKS

1. Quality in the Construction Project by Fox, Arthur J., and Holly A. Cornell, American Society of Civil Engineers, New York, Latest Edition.
2. Total Quality Management by Mohantry R.P. and Lakhe R.R., Jaico Publishing House, Mumbai, 2000.
3. Total Quality Management by Break Joseph and Susan Joseph, Excel Books, New Delhi, 1995.
4. Total Quality in Construction Projects by Hellard R.B.: Achieving profitability with customer satisfaction, Thomas Telford, London, 1993.
5. Quality Management by Manjual, Satish, Raj Publishing House, Jaipur, 1999.

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ADVANCED HYDRAULICS			
Course Code	**21CVE117**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. **Illustrate** Chezy's and Manning's formulae and **determine** most economical channel section.
2. **Explain** specific energy and **compute** critical flow in non-prismatic channels
3. Derive dynamic equations of gradually varied flow and compute draw down and back water curves
4. **Make use** of hydraulic jump as energy dissipater
5. **Explain** pipe network analysis and **analyse** pressure distribution system.

UNIT – I

Open Channel Flow:
Kinds of open channel flow, channel geometry, types and regimes of flow Velocity distribution in open channel, Uniform Flow **–** features of uniform flow, Manning's and Chezy's formula- rigid and mobile boundary channels, determination of roughness coefficients
Determination of normal depth and velocity, most economical sections, non-erodible channels, Flow in a channel section with composite roughness, flow in close conduit with open channel flow, wide open channel, specific energy, critical flow and its computation in non-prismatic channels. **15 Hours**

UNIT - II

Varied Flow:
Dynamic equations of gradually varied flow, assumptions and characteristics of flow profiles, classification of flow profile, draw down and back water

curves(M1 and M2 type) profile determination, graphical integration, direct step and standard step method, numerical methods.

Hydraulic Jumps: momentum in open channel flow, specific force, derivation of conjugate depths, types, basic characteristics, length and location, jump as energy dissipation, control of jump, surges. **15 Hours**

UNIT – III

PIPE NETWORK:

Water distribution, network analysis, analysis of pressure distribution system-equivalent pipe and Hardy cross method, software application. **9 Hours**

Course Outcomes:

At the end of the course the student should be able to

1. **Determine** most economical channel sections for rigid and mobile boundary channels applying Chezy's and Manning's formulae and **compute** critical flow in non-prismatic channels
2. **Explain** and **compute** specific energy in non-prismatic channels
3. Develop dynamic equations of gradually varied flow, **classify** the flow profiles and **compute** length of draw down and back water curves
4. **Develop** conjugate depth relationship and **make use of** hydraulic jump as energy dissipater.
5. **Analyse** pressure distribution system in pipe network

Course Articulation Matrix:

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

Note: 1: Low 2: Medium 3: High

TEXTBOOKS:

1. Modi, P.N. and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House, 22nd edition, 2019.
2. Rangaraju K G, "Flow through open channel", McGraw Hill Publications, 2nd edition 2001.

REFERENCE BOOKS:

1. A. K. Jain., "Fluid Mechanics", Khanna Publishers, New Delhi. 8th edition, 1995.
2. V. T. Chow: "Open-channel hydraulics." McGraw Hill Publications ,2009
3. K. Subramanya "Flow in open channels" Mc Graw Hill India, 4th edition 2015.
4. Santhosh Kumar Garg., Water Supply Engineering, Khanna Publishers, New Delhi, 33 Edition,2010

NPTEL ONLINE SOURCE:

http://nptel.ac.in/courses/105103021

http://nptel.ac.in/courses/105105201

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ENVIRONMENTAL IMPACT ASSESSMENT FOR CIVIL ENGINEERING			
Course Code	**21CVE118**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Identify the need to assess and evaluate the impact of projects on environment.
2. Explain major principles of environmental impact assessment.
3. Understand the different steps within environmental impact assessment.
4. Appreciate the importance of EIA for sustainable development and a healthy environment.

UNIT – I

Evolution of EIA: Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and Comprehensive EIA, General Framework for Environmental Impact Assessment. **15 hours**

UNIT - II

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment, Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation, Fault tree analysis, Consequence Analysis. **16 hours**

UNIT – III

Introduction to Environmental Management Systems, Environmental management plan-Post project monitoring, Environmental Audit: Cost Benefit Analysis, Life cycle Assessment. Case studies on project, regional and sectoral EIA. **09 hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand phenomena of impacts and know the impact quantification of various projects in the environment.
2. Liaise with and list the importance of stakeholders in the EIA process.
3. Know the role of public in EIA studies.
4. Overview and assess risks posing threats to the environment.
5. Assess different case studies/examples of EIA in practice.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1				2	3	2					2	3	
CO2	1	1				2	3	2					2	3	
CO3	1	1				2	3	2					2	3	
CO4	1	1				2	3	2		3			2	3	
CO5	1	1		3		2	3	2				3	2	3	

Note: - 1: Low 2: Medium 3: High

TEXTBOOKS:

1. Noble, L. 2010. Introduction to environmental impact assessment. A Guide to Principles and Practice. 2nd edition. Oxford University Press, Don Mills, Ontario.
2. Larry W. Canter, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996

REFERENCE BOOKS:

1. Morris and Therivel, 2009. Methods of Environmental Impact Assessment, 3rd edition. New York, NY: Routledge.
2. Hanna, K.S. 2009. Environmental impact assessment. Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario.

NPTEL SOURCES:

http://nptel.ac.in/courses/120108004/
http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

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GROUND WATER HYDROLOGY & EXPLORATION			
Course Code	**21CVE119**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable the students to:

1. **Develop** an understanding on the fundamentals of groundwater hydrology, **appraise** its Significance and **Inspect** the techniques of groundwater exploration, development and management.
2. **Explain** the occurrence and distribution of subsurface water, **list** and **distinguish** the types of aquifers, wells and their characteristic properties.
3. **Explain** aquifer parameters, **analyze** pump test and Darcy' Law governing the steady unidirectional groundwater flow.
4. **Explain** Well hydraulics and **estimate** the aquifer parameters in steady and unsteady state radial flow into unconfined and confined aquifers.

UNIT – I

INTRODUCTION: Vertical distribution of subsurface water and its occurrence. Aquifer and its types, water bearing properties of rocks and their classification.

FUNDAMENTALS OF GROUND WATER FLOW: Aquifer parameters-porosity, permeability, Specific yield, specific retention, hydraulic conductivity, storage coefficient, transmissibility, Pump tests, recuperation tests, interference of wells; Darcy's law, steady unidirectional flow in confined and unconfined aquifers. **16 Hours**

UNIT – II

WELL HYDRAULLCS:

Steady state Radial flow in confined and unconfined aquifer, Thiem's equilibrium formulae; Estimation of Discharge and Transmissivity.

Unsteady state Radial flow: Aquifer parameters, General equation derivation- Theis's method, Cooper-Jacob method, Chow's method, solution of unsteady flow equations. **15 Hours**

UNIT - III

GROUNDWATER EXPLORATION, DEVELOPMENT AND MANAGEMENT: Remote sensing and Geophysical methods, Electrical Resistivity methods, types of wells and yield of a well. Methods of construction, tube well design, dug wells, well development, pumps for lifting water - working principles, power requirement. Resource Management, Conjunctive use - necessity, techniques and economics. **8 hours**

Course Outcomes:

At the end of the Course students will be able to

1. Illustrate the vertical distribution and occurrence of subsurface water, List and distinguish the water bearing properties of the rocks, the types of aquifers and their characteristic properties
2. List and explain aquifer parameters, analyze pump test and Darcy' Law in steady state unidirectional groundwater flow.
3. Explain equilibrium Well hydraulics and estimate the aquifer parameters in steady state radial flow in the unconfined and confined aquifers
4. Explain in-equilibrium Well hydraulics and estimate the aquifer parameters in unsteady state radial flow in the unconfined and confined aquifers using appropriate methods.
5. List and categorize types of wells, inspect and explain advanced techniques of groundwater exploration, development and management using remote sensing, geophysics and GIS.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2											1		
CO 2	3	2				2							2		
CO 3	2	3				2							2		
CO	2	3				2							2		

4															
CO 5	3	2				2	2						2	2	

Note: 1: Low 2: Medium 3: High

TEXTBOOKS:

1. Todd, D. K., (2006) "**Groundwater Hydrology**", John Wiley and Sons, Singapore
2. Ramakrishnan, S. (2011) "**Ground Water**", 2nd edition, Scitech publications (India) Pvt. Ltd., Chennai
3. Garg, S. K. (2010) "**Hydrology and Water Resources Engineering**" Khanna Publishers, New Delhi

REFERENCE BOOKS:

1. Karanth, K.R. (1987) "**Groundwater Assessment, development and Management**", Tata McGraw Hill
2. Raghunath, H.M., (2007) "**Groundwate**r", New Age International Publishers, New Delhi
3. Patel, A.S., and Shah, D.L., (2008), "**Water management**" New Age International Publishers, New Delhi
4. Bower H., (1978), **Groundwater Hydrology**, - McGraw Hill. .
5. Walton W.C., (1970), "**Groundwater Resource Evaluation**", Mc Graw Hill Publication, New Delhi.

Online reference:

http://nptel.ac.in/courses/105101010/38#
https://nptel.ac.in/courses/105/103/105103026/
https://nptel.ac.in/courses/105/105/105105042/

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REMOTE SENSING & GIS APPLICATIONS IN WATER RESOURCES ENGINEERING			
Course Code	**21CVE120**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

The course will enable the students to:

1. **Explain** the basic principles of Geoinformatics comprising Remote sensing, Photogrammetry, GPS, GNSS& GIS
2. **Explain** the stages and techniques of photogrammetry, aerial photo interpretation, visual & digital image processing, enhancement and interpretation.
3. **Explain** and **Appraise** GIS - its components, data structures, process and operation, Map and its projections, components, preparation and overlays
4. **List, Explain and appraise** the significance of GEOMATICS in various Water Resource Engineering practices

UNIT – I

Remote sensing and its principles: Physics of Remote sensing, EM spectrum, Blackbody concept, atmospheric windows, spectral response of common earth features.

Platforms & Sensors: Ground based, Air borne and Space borne platforms, Active and Passive Sensors, Photographic sensors, scanners, radiometers, RADAR and thermal infrared, hyper spectral remote sensing, Indian satellites and sensors: capabilities, data products

Photogrammetry: Basic principles of Aerial photography and Photogrammetry, Flight procedures, Aerial Photo Interpretation and Analysis techniques.

Satellite Image Interpretation and Analysis techniques: Visual & Digital Image interpretation, Interpretation elements, False Colour Composites (FCC). **16 Hours**

UNIT – II

Digital Image Processing, Analysis and GIS: Digital image formats, pre-processing and processing (DIP), image restoration/enhancement procedures, information extraction, pattern recognition concepts, post processing procedures.

Geographic Information System -concept and spatial models: Fundamentals of GIS, spatial and non-spatial data, Vector and Raster GIS,

GIS Hardware and software, GPS & GNSS, georeferencing, digitization, Thematic Maps, Overlay Analysis, Operation of GIS, Co-ordinate systems and map projections, Map scale, data display and cartography. **15 Hours**

UNIT – III

RS & GIS Applications in Civil Engineering: Watershed characteristics, Soil moisture analysis, Water quality assessment and monitoring, flood mapping and monitoring, Village resource mapping, Smart City Development, Groundwater inventory, coastal environmental studies. **08 Hours**

Course Outcomes:

At the end of the course, upon successful completion, each student will be able to:

1. **Define** and **explain** the principles of Remote Sensing, and **list** various types of platforms, sensors & resolutions in RS with a special reference to Indian satellites and data products.
2. **Explain** Photogrammetry, its basic principles, elements of photo interpretation and Visual& Digital Image interpretation techniques.
3. **Explain** different stages involved in Digital Image Processing, various image enhancement techniques, **list** and **classify** the digital image formats and the extracted information for various purposes.
4. **Explain** and **Appraise** GPS, GNSS & GIS - their components, data structures, process and operation, Map and its projections, components, preparation and Overlays.
5. **List** the applications and **explain** the significance of geospatial technology or GEOMATICS (Photogrammetry, RS, GPS, GNSS & GIS) in various fields of Water Resource Engineering practices.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	2											2	2	
CO 2	2	2				2	1						2	2	
CO 3	2	2				2	1						2	2	
CO	2	2				2	1						2	2	

4															
CO 5	2	2				2	1						2	2	

1/L: Slight (Low) 2/M: Moderate (Medium) 3/H: Substantial (High)

TEXTBOOKS:

1. Anji Reddy, M. (2012) Text Book of Remote Sensing and Geographical Information Systems, Fourth Edition, BS Publication, Hyderabad
2. Bhatta, Basudeva (2011) Remote Sensing and GIS, 2nd edition, Oxford University Press, New Delhi
3. Lillesand, T.M., Kiefer, R.W and Chipman, J.W. (2015) Remote sensing and Image Interpretations, 7th edition, John Wiley and sons, New Delhi

REFERENCE BOOKS:

1. Anji Reddy, M. and Hari Shankar, Y. (2006) ***Digital Image Processing,*** BS Pub., Hyd.
2. Bernhardsen, Tor (2002) ***Geographic Information Systems-3rd*** Ed., Wiley India, Delhi
3. Canada Centre for Remote Sensing **(2011)** ***Fundamentals of Remote sensing-Tutorial***
4. Chang, Kang-tsung (2008) ***Introduction to Geographic Information Systems*** 4th Ed.,

   Tata McGraw Hill Publishing Company Limited, New Delhi
5. Korte, George B. (2001), ***The GIS Book***, Onword Press, Thomson Learning Inc.,USA
6. Kumar, S. (2008) ***Basics of Remote sensing and GIS,*** Laxmi Publications (P) Ltd., Delhi
7. Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., (2004), ***Geographic Information Systems and Science*** John Wiley & Sons Ltd., ESRI Press
8. Sabins, F.L. (1997) ***Remote Sensing: Principles and Interpretation,*** 3rd edn. WH Freeman and Company, New York, 494p.

NPTEL SOURCES

- https://www.youtube.com/user/edusat2004
- https://eclass.iirs.gov.in/login

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RURAL WATER SUPPLY AND SANITATION			
Course Code	**21CVE121**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to:

1. Understand importance of water, drinking water standards, water treatment methods and different types of rural water supply systems.
2. Learn different rural sanitation methods and its importance, rain water harvesting and its uses.
3. Create awareness on communicable diseases and its control measures.
4. Understand different methods of Refuse collection methods and its disposal.
5. Provide the knowledge on Milk sanitation, quality control of milk.

UNIT – I

Rural water supply - Introduction: Need for a protected water supply, investigation and selection of water sources, various techniques for rural water supply, protection of well waters, drinking water quality standards water treatment methods – disinfection, deflouridation, hardness and iron removal, ground water contamination and control

Rural sanitation-Conservancy, public latrine, concept of Eco-sanitation, trenching and composting methods, Two pit latrines, aqua privy, W.C, septic tank, soak pit. Drainage Systems: Storm water and sullage disposal, rain water harvesting and uses. **15 Hours**

UNIT – II

Communicable diseases- Terminology, water borne diseases, classifications, methods of communication, general methods of control.

Disease vectors: House fly and mosquito – life cycle, diseases, transmission and control measures.

Refuse collection and disposal-Garbage, ash, rubbish, collection methods, transportation, disposal- salvaging, dumping, controlled tipping, incineration, composting, dung disposal-digester, biogas plant. **15 Hours**

UNIT – III

Milk sanitation- Essentials, test for milk quality, pasteurization, quality control, cattle borne diseases, planning for a cow shed**.** **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. **Identify** problems in rural water supply and monitor, quality and maintenance of rural water supply, **design** low cost water treatment system for rural areas.
2. **Explain** rural sanitation, management of grey, storm water and **recognize** types of waste water treatment systems.
3. **Outline** the safe disposal methods of solid wastes.
4. **Illustrate** types of diseases and preventive measures.
5. **Ensure** quality of milk and preventive **measures** for cattle borne diseases.

Mapping of POs & COs:

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

Note: 1: Low 2: Medium 3: High

TEXT BOOKS:

(a) Joseph A. Salvato (1992), "Environmental Engineering and Sanitation" Wiley publications.

(b) E.W Steel (1979), "Water supply & Sanitary Engineering". McGraw-Hill publications.

(c) Terence J. McGhee, E.W. Steel (1991), "Water Supply and Sewerage". McGraw-Hill publications.

REFERENCE BOOKS:

1. Park and Park (2017) "Preventive & Social Medicine", McGraw-Hill, publications. 24th edition.
2. B.C Punmia & Ashok Jain. (2009) "Environmental Engineering-II", Lakshmi publications.
3. Cairncross, S. and Feachem, R. (2000) Environmental Health Engineering in the Tropics, John Wiley & Sons, 306 p.
4. Dangerfield, B. J. (1983)Water Supply and Sanitation in Developing Countries, The Institution of Water Engineers and Scientists, London, England.
5. McGhee, T. J. (1991) Water Supply and Sewerage, McGraw-Hill, 602 p.
6. Morgan, P. (1990) Rural Water Supplies and Sanitation, Macmillan Education Ltd, 358 p.
7. Qasim S. R., Motley E. M., Zhu G., (2000) Water Works Engineering – Planning, Design and Operation, Prentice-Hall PTR, Upper Saddle River, NJ 07458.
8. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing Company, Huntington, New York.
9. Winbald, U., and Simpson-Hebert, M., Ecological Sanitation, SEI, Stockholm, Sweden.
10. Kadlec R.H. and Wallace S.D., Treatment Wetlands, CRC Press, Boca Raton
11. Wastewater Engineering – Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill

NPTEL SOURCES

https://nptel.ac.in/courses/105/104/105104102/
http://www.pbdwss.gov.in/dwss/left_menu/major_schemes_projects.html
https://www.classcentral.com/course/water-1364
https://www.classcentral.com/course/sanitation-2230

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3D BIM - AUTODESK REVIT			
Course Code	**21CVE122**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**1:0:4**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

During the course students will be enable

1. To know the interface of the Revit world and create the model, views, structural items.
2. To add stairs, ramps, railings, floors and roofs in the model
3. To create the ceilings, interiors, dimensioning, annotating and working with revit edit tools.
4. To show the detailing of the model, creating specific views, area plans.
5. To complete the project by using Autodesk Revit tool

UNIT – I

The Autodesk Revit World - The Revit Interface, the Project Browser, File Types and Families.

Creating a model - Placing Walls, Using Reference Planes, Editing Wall Joins, Placing Doors and Windows.

Creating views –Creating levels, creating and modifying building sections, adding wall section, creating detail sections, creating callouts, creating and modifying a camera view, creating an elevation.

Structural items – Adding structural grids, structural columns, structural framing, foundation systems, structural footings.

Stairs, Ramps, and Railings – Creating stairs by using rise/run function, winding staircase, custom railing system, custom stairs, adding ramps.

Floors – Placing floor slab, building a floor by layers, splitting floor materials, pitching a floor to a floor drain, creating shaft openings.

Roofs – Placing roofs by footprint, creating a sloping roof, creating roof by extrusion, adding a roof dormer. **15 hours**

UNIT - II

Ceilings and interiors – creating ceilings, ceiling openings and soffits, interior design, alternate floor materials

Working with the Revit tools – Basic edit, Array, mirror, align, split element.

Dimensioning and Annotating – Selecting and applying dimensioning, placing text and annotation.

Detailing – Working with line weights, drafting on top of the detail, adding notes, creating blank drafting views.

Creating specific views and match lines – Duplicating views, creating dependent views, adding match lines.

Creating sheets and printing, creating rooms and area plans. **15 hours**

UNIT - III

Project based learning

Create a building model of dimension 50' x 80'. Should include the following features; Plan, Elevation, Section details, Electrical layout, plumbing layout, landscaping, 3D views. 10 **hours**

Course Outcomes:

At the end of the course the students should be able to

1. To ***illustrate*** the interface of the Revit world and create the ***model***, views, structural items. (L3)
2. ***Model*** stairs, ramps, railings, floors and roofs. (L3)
3. ***Create*** the ceilings, interiors, dimensioning, annotating and working with revit edit tools. (L3)
4. ***Model,*** show the detailing of the ***plan*** by creating specific views and represent the area plans. (L3)
5. ***Create*** the project by using Autodesk Revit tool (L6)

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial

(High)

References

1. Eric Wing, "Autodesk Revit 2017 for Architecture No experience required", Autodesk authorized publisher.
2. "Autodesk® Revit®2015 Getting Started Guide", Autodesk authorized publisher.
3. "Revit shortcuts guide", Autodesk authorized publisher.

CAD IN CIVIL ENGINEERING			
Course Code	**21CVE123**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**1:0:4**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives

This Course will enable students to

1. **Understand** the analysis by software tool.
2. **Identify** different types of methods of analysis using software's
3. **Assess** the geotechnical problems using industry best software's
4. **Analyse** the strength of various types of structural members as per the codal provisions.
5. **Design** the various civil Engineering structures using software's

UNIT – I

STRUCTURES: Structural Analysis of 2D and 3D Trusses, Structural Analysis of Continuous Beams using for different types of loadings and support conditions.
Structural Analysis of 2D and 3D Rigid and Braced Frames for different types of loadings, support conditions, section orientations and stiffness variation between columns and beams.

15Hours

UNI - II

GEOTECHNICAL: Analyzing and design of retaining walls using CAD software. **15 Hours**

UNIT - III

DESIGN: Creating design sheets using Microsoft Excel. **10 Hours**

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

1. Explain the types analysis, structural analysis methods and procedure (L2)
2. Create 2D and 3D Models for analysis with various end conditions. (L3)
3. Plan a column orientation for different types of buildings (L5)
4. Analyse Retaining wall and 3D frames. (L3)
5. Design the analysed structures using MS Excel. (L6)

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

References

1. Punmia B. C., Ashok Kumar Jain, Arun Kumar Jain, "Strength of Materials and Theory of Structures", Volume I & Volume II, Laxmi Publications (P) Ltd., 2019.
2. Ramamrutham S., "Theory of Structures", Dhanpat Rai & Sons, New Delhi, 2018.
3. N. Krishnaraju and R. N. Pranesh, Reinforced Concrete Design (IS456:2000)-Principles and Practice, New Age International Publishers, New Delhi, 2006.
4. Dr. Ramchandra and Virendra Gehlot, Limit State Design of Concrete Structures (As per IS: 456-2000), Scientific Publishers (India), Jodhpur, 2010.
5. Punmia B.C.(2017) "Soil Mechanics and Foundations", Laxmi Publishing Co
6. IS: 456-2000 (to be supplied in the examination), SP16.

Scheme of Evaluation

CIE

A project report should include Analysis of beams with different end conditions, Analysis of 2D and 3D portal frames.

1. Analysis of beams and frames.
2. Design sheets for buildings and retaining wall

SEE

- Analysis or Beams and frames software : 10 Marks
- Analysis of Retaining walls : 10 Marks
- Design sheet for beams and columns : 10 Marks
- Design Sheet for retaining wall : 10 Marks

3. Viva voce : 10 Marks
- Total : 50 Marks

FUNDAMENTALS OF MACHINE LEARNING			
Course Code	**21CVE124**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**1:0:4**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to:

1. Understand the need and basics of machine learning.
2. Learn ANN and Decision Tree model.
3. Explore the various learning algorithms using Supervised Learning.
4. Understand the important aspects of Analytical Learning and difference between Analytical and Inductive Learning Algorithms.
5. Analyse the techniques related to reinforcement learning.

UNIT – I

Introduction: Well posed learning problems, designing a Learning system, Perspectives and Issues in Machine Learning.

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version Space and Candidate Elimination Algorithm, Inductive Bias.

Decision tree: Representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm. Hypothesis Space Search, Inductive Bias, Issues in Decision Tree Learning.

Artificial Neural Networks: Introduction, Neural Network Representations, Appropriate problems, Perceptrons, Back propagation algorithm. **16 Hours**

UNIT – II

Instance Based Learning: k-nearest neighbour learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

Bayesian Learning: Bayes theorem, Bayes theorem and concept Learning, Maximum Likelihood, Minimum Description Length, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, Bayesian Belief Networks, EM Algorithm.

Analytical Learning: PROLOG-EBG, Explanation Based Learning.

Combining Inductive and Analytical Learning: Inductive–Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Alter the Search Objective, Augment Search Operators. **15 Hours**

UNIT – III

Reinforcement Learning:

Learning Task, Q Learning, Non Deterministic Rewards and Actions, Temporal Difference Learning. **09 Hours**

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire the fundamental concept and importance of machine learning.
2. Demonstrate the application of Decision Tree and ANN and Genetic algorithm for real world problems.
3. Design and implement algorithms for supervised learning system.
4. Design and implement algorithms for Analytical and Inductive Learning.
5. Develop machine learning algorithm and reinforcement techniques for real world problems.

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. T. M. Mitchell, "Machine Learning", McGraw Hill, 2017.

REFERENCE BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, The MIT Press, 2004.
2. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
4. R. O. Duda, P. E. Hart and D. G. Stork, "Pattern Classification", Wiley Publications, 2001.
5. T. Hastie, R. Tibshirani, J. Friedman. "The Elements of Statistical Learning", 2nd edition, 2008.
6. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
7. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
8. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
9. S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.

E-Books / Online Resources:

1. https://in.mathworks.com/
2. https://www.kdnuggets.com/
3. https://blog.cambridgespark.

MOOC:

1. https://www.udemy.com/topic/

2. https://www.mooc-list.com/

3. https://peltarion.com (Build and deploy AI with deep learning platform)

GIS WITH QUANTUM GIS

Course Code:	**21CVE125**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P: S):	**2:0:2:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Civil Engineering

Course Objectives: This Course will enable students to

1.	Explain the basic principles of remote sensing
2.	Summarize the concepts of VIP and DIP
3.	Explain the components and principles of GIS
4.	Study the photogrammetry techniques
5.	Explains the concepts of GPS and applications

UNIT - I

Introduction; Remote Sensing	**16 Hours**

Basics: Fundamentals of Remote Sensing, Electromagnetic Spectrum, Process of remote sensing, Blackbody Radiation, Energy Interactions with earth atmosphere and surface features, spectral reflectance curves-For Vegetation, soil & water.
Sensors: Definition, Types (Typical Sensor used in optical remote sensing, Thermal sensor, Synthetic Aperture Radar)

UNIT - II

VIP and DIP	**15 Hours**

Visual Image Interpretation: Definition, Objectives, Keys & Elements of Visual Image interpretation. Digital Image Processing (DIP): Definition, Need, Stages of DIP-Image rectification & restoration,

UNIT - III

GIS & GPS | **09 Hours**

Introduction, basics of GIS- definition of GIS, components of GIS, GIS work flow, representing
spatial data, raster and vector data.
Coordinate systems and map projections, datums, spatial data input, Non spatial data Brief introduction to measurements in GIS.
Global Positioning System, The 3 segments of GPS, How GPS Works, Triangulation, Sources of GPS Error, GPS Terminology, Applications

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

1.	Explain the concepts of remote sensing
2.	Interpretation of digital images
3.	Explain the components of GIS
4.	Understand the photogrammetric technique
5.	Explain the application of RS and GIS

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
21CVE905.1	2	1	2	1	-	-	-	-	-	-	-	1	1	2	1
21CVE905.2	2	1	2	1	-	-	-	-	-	-	-	1	1	2	1
21CVE905.3	2	1	2	1	-	-	-	-	-	-	-	1	1	2	1
21CVE905.4	2	1	2	1	-	-	-	-	-	-	-	1	1	2	1
21CVE905.5	2	1	2	1	2	-	-	-	-	-	-	1	1	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Lillesand T.M., and R.W. Kiefer, "Remote sensing and Image interpretation", 4th edition, John Wiley & Sons – 2012.
2.	Christopher Jones "GIS and Computer Cartography"publication Prentice-Hall(2009)
3.	Lilly Sand, "Remote sensing and Image interpretation, John Willey and Sons, New York 1999.
4.	Manoj K. Arora, R.C. Badjatia, " Geomatics Engineering", Nemichand & Bros. Roorkee –2011.

REFERENCE BOOKS:	
1.	Chang, "Geographical Information Systems", McGraw Hill Book Co., 2007.
2.	Jensen J.R., "Introductory digital image processing: A remote sensing perspective", 2nd Edition, Prentice Hall – 1996.
3.	T.M Lillesand,. R.W Kiefer,. and J.W Chipman, Remote sensing and Image interpretation , 5th edition, John Wiley and Sons India.
4.	Richards J A., X. Jia, "Remote sensing digital image analysis: an introduction", 3 rd Edition, Springer - 1999.
5	Peter A. Burrough & Rachel A. McDonnel "Principles of geographic information systems"- (1998), Oxford University press, Great Britain.
6	Mather P.M., "Computer processing of remotely sensed images: an introduction", Wiley. – 1988.
E Books / MOOCs/ NPTEL	
1.	https://onlinecourses.nptel.ac.in/noc20_de04/preview
2.	https://onlinecourses.nptel.ac.in/noc22_ce26/preview

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PYTHON PROGRAMMING			
Course Code	**21CVE126**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**1:0:4**	**SEE Marks**	**50**
Total Hours	**40**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Explain the elementary programming constructs and file operations and use it in Python programming.
2. Describe the concepts like strings, conversion of strings to numbers, lists, tuples, and dictionaries and use these in the python programming.
3. Illustrate the object oriented programming concepts in Python.

4. Construct a Graphical User Interface (GUI) and write a multi-threaded and a Client/Server program in Python.
5. Perform the database connection and Common Gateway Interface (CGI) programming in Python and Visualization with Matplotlib.

UNIT – I

Introduction to python, the concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program.

Understanding error messages; Conditions, boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short circuit evaluation.

Strings and text files; manipulating files and directories, text files: reading/writing text and numbers from/to a file.

Indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers. Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists.

Dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries. **15 Hours**

UNIT - II

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects inheritance, polymorphism, operator overloading (_eq_,_str_, etc); abstract classes; exception handling, try block.

Graphical user interfaces; event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames. **16 Hours**

UNIT – III

Visualization with Matplotlib - General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density

Creating simple web clients, introduction to CGI, CGI module, building CGI applications, python web application frameworks. **09 hours**

Course Outcomes:

At the end of the course the student will be able to:

1. Explain the basic program constructs and file operations in Python and express it.
2. Design the Python programs using the concepts like strings, conversion of strings to numbers, lists, tuples and dictionaries.
3. Implement the functions and object oriented programming concepts in python.
4. Create a Graphical User Interface, multiple threads and Client/Server programs in python.
5. Implement a database connection and CGI programs in python.

Mapping of POs & COs:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning,
2. Magnus Lie Hetland, Beginning Python from Novice to Professional, Second Edition.
3. Mark Summerfield, Programming in Python 3 - A Complete Introduction to the Python Language, Second Edition.
4. Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, ISBN: 978-0-13-274718-9, 2013.

REFERENCE BOOKS:

1. Chun, J Wesley, Core Python Programming, 2nd Edition, Pearson, 2007 Reprint 2010.
2. Python Cookbook, Third Edition, David Beazley and Brian K. Jones, Shroff Publishers & Distributors Pvt. Ltd., ISBN : 978-93-5110-140-6

3. Learning Python, Fifth Edition, Mark Lutz.

4. Programming Python (English) 4th Edition Mark Lutz.

5. Testing Python, David Sale, Wiley India (P) Ltd., ISBN: 978-81-265-5277-1.

Professional Elective Course - 2 (Group 2)

EARTHQUAKE RESISTANT STRUCTURES

Course Code:	**21CVE201**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To provide the basic knowledge of Earthquake and seismic zoning of India.
2.	To study the performance of buildings due to irregularity during Earthquake
3.	To apply the knowledge of mathematics, science and engineering to analyze linear structural systems subjected to earthquake forces.
4.	To study the detailing of Earthquake resistant RCC buildings and to gain basic knowledge on geotechnical earthquake engineering.
5.	To study the code provisions for Earthquake resistant masonry and earthen buildings. And also to apply the knowledge of mathematics, science and engineering to analyze linear structural systems of masonry buildings.

UNIT-I

15 Hours

Introduction:

Engineering Seismology – Internal structure of earth, Geology of Earth, Definitions, Classification of Earthquakes, Causes of Earthquakes, Seismic waves, Theory of plate tectonics, Elastic rebound theory, Intensity and Magnitude of earthquake, Seismic measuring equipment's.

Seismic Response of Buildings:

Effect of Structural Irregularities on seismic performance of RC buildings. Vertical irregularity and plan configuration problems, Seismo resistant building architecture –lateral load resistant systems, Building characteristics.

UNIT-II

15 Hours

Earthquake Resistant Design Concepts:

Seismic zones of India, Design Philosophy and principle of Earthquakes Resistant Design, Guidelines for Earthquakes Resistant Design. Equivalent static force method-Assumptions, evaluation of Earthquake forces as per IS: 1893-2016. Dynamics analysis procedure- Response spectrum Method. Liquefaction–Causes and remedial measures.

UNIT-III

10 Hours

Seismic Analysis of Masonry Buildings –*Lessons learnt from past earthquakes on the performance of masonry and earthen buildings*. Elastic properties of structural masonry, Failure of masonry building- Causes, failure modes. Steps for improving seismic performance of masonry buildings- Design considerations, provisions of IS: 4326-1993 for design of masonry buildings.

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

1.	**Acquire** knowledge on basic concepts of earthquake engineering and seismic zones of India.
2.	**Explain** the suitability of building plan and configuration for an earthquake prone area.
3.	**Determine** earthquake forces in a building as per IS 1893:2016 provisions and **analyze** the failure of RC buildings.
4.	**Analyze** the structure using dynamic analysis procedure and **acquire** knowledge of geotechnical earthquake engineering.
5.	**Analyze** and **design** the masonry buildings subjected to seismic

	forces.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE201.1	1	1	2			1	1						1	2	
21CVE201.2	1	2	3			1	1						1	2	
21CVE201.3	1	2	3			1	1						1	2	
21CVE201.4	1	2	3			1	1						1	2	
21CVE201.5	1	2	3			1	1						1	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Jaikrishna et al., Elements of Earthquake Engineering, South Asia Publishers, New Delhi. 1st edition December 2000, reprinted 2014.
2.	Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, PHI, India.2nd edition 2015.
3.	Chopra, A.K., Dynamics of Structures, Prentice-Hall of India Pvt. Ltd. New Delhi. 1st edition 2011.
4.	S K Duggal, Earthquake Resistant Design of Structures, Oxford University press, 2007.
5	Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw Hill Pub
6	Anderson, R .A., "Fundamentals of Vibrations", Mc Millan
7	IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
8	Timoshenkeo, S., "Vibration and Structural Dynamics", Van Nostrand Co.
9	Clough and Penzien, "Dynamics of Structures". McGraw Hill

10	Mukyopadhyaya, "Vibration and Structural Dynamics", Oxford & IBH
11	James Ambrose and Dimitry Vergun, "Design for Earthquakes".
12	David Key, "Earthquake Design Practice for Buildings", Thomas Telford
REFERENCE BOOKS:	
1.	Clough, R.W. and Penzien J, Dynamics of Structures, McGraw Hill Book Co. New York 3rd edition 2003.
2.	S. R. Damodarasamy and S. Kavitha, , Basics of Structural Dynamics and Aseismic Design, PHI Learning Private Limited,New Delhi, latest print 2015.
3.	Biggs, M., An Introduction to Structural Dynamics, McGraw Hill Book Co. New York, January 1964.
4.	PAZ M., Structural Dynamics, CBS Publishers, New Delhi. July 1997.
5	Dowrick D.J., "Earthquake Resistant Design" John Wiley & Sons, London, 2009.
6	Shrikande M. & Agarwal P. "Earthquake Resistant Design of Structures" Prentice Hall (India) Ltd, New Delhi, 2006.
7	Dr. Vinod Hosur , "Earthquake Resistant Design of Building Structures" John Wiley & Sons, London
E Books / MOOCs/ NPTEL	
1.	Manuals/guidelines/reading materials to be downloaded from http://www.nicee.org

DESIGN OF BRIDGES

Course Code:	**21CVE202**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Learn the components and classification of bridges.
2.	Understand the IRC codal provisions for bridge design.
3.	Learn the concepts in analyzing & designing the pipe and slab culverts.
4.	Understand the analysis & design of slab and girder of T-beam bridges.
5.	Understand the importance of bearings and joints in bridges.

UNIT-I

15 Hours

INTRODUCTION TO BRIDGES: History, components, classification, selection of site, linear waterway, scour, afflux.
Foundation: types of foundation (Pile, Raft, Well and Caisson – Brief Description only) cofferdam.
Substructure: types of abutment, piers, wing walls– forces acting on them and empirical designs – bank connection and protection works
BRIDGE LOADING STANDARDS: Loads to be considered while designing road bridges as per IRC (Indian Road Congress), impact factors, Indian railway bridge loading standards.

UNIT-II

16 Hours

CULVERTS: Computation of water discharge, design of pipe culverts and slab culverts for IRC class AA and class-A loading.
T-BEAM BRIDGES: Pigeaud's method for computation of interior slab moments, design of interior slab panel of T-beam bridge for IRC class AA tracked vehicles, courbon's method for computation of moments in girders.

UNIT-III

09 Hours

BEARINGS, JOINTS AND APPURTENANCES
Importance of bearings, bearings for slab bridges, bearings for girder bridges, expansion bearings, fixed bearings, elastomeric bearings, bearings for skew bridges, joints and appurtenances.

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

1.	Explain the components of bridges and classify them.
2.	Explain the IRC codal provisions for road and railway bridge design.
3.	Estimate the water discharge, analyse and design the pipe and slab culverts as per IRC 6 : 2016 part II, IS 458 : 2003, IS 456 : 2000 and IRC 21 : 2000.
4.	Analyse and Design the interior slab panels and girders of T Beam bridges as per pigeaud's method and courbon's method respectively using IS 456 : 2000 and IRC 6 : 2016 part II.
5.	Explain the importance and types of bearings and joints in bridges.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE202.1	1											1		1	
21CVE202.2	2											1	1	2	
21CVE202.3	1	2	3					1				1	3	2	1
21CVE202.4	1	2	3					1				1	3	2	1
21CVE202.5	1											1	1	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Johnson Victor, "Essentials of bridge Engineering", Sixth edition, Oxford and IBH publications, 2007.
2.	Krishna Raju, "Design of Bridges", Fourth edition, Oxford and IBH publications, 2009.

REFERENCE BOOKS:

1.	Jagadish T.R. & Jayaram M.A., "Design Of Bridge Structures", Second Edition, Prentice Hall Of India Private Limited, 2004
2.	Ponnuswamy. S.' 'Bridge Engineering', Tata Mcgraw-Hill Publishing Co. New Delhi, 2008.
3.	M.G.Aswani, V.N Vazirani & M.M. Ratwani, 'Design of Concrete Bridges Second Edition, Khanna Publishers,2013
4.	S.P.Bindra, 'Principles and Practice of Bridge Engineering', Ninth Edition Dhanpat Rai publications,2016

E Books / MOOCs/ NPTEL

1.	Nptel.ac.in/courses/105105165.
2.	
3.	

ADVANCED RCC DESIGN OF STRUCTURES

Course Code:	**21CVE203**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Analyze of slabs by yield line approach and Design flat slab.
2.	Analyze and design of grid slabs by approximate method.
3.	Design the continuous beams with moment redistribution
4.	Analyze and design Silos and Bunkers
5.	Understand the behavior of shells and folded plates.

UNIT-I

14 Hours

Analysis of Slabs: Boundary conditions and yield line pattern at failure, Yield line analysis of slabs with equilibrium method and virtual work method.
Design of flat slabs by Direct Design Method (with drops)

UNIT-II

16 Hours

Design of grid floors
Design of continuous beams with redistribution of moments

UNIT-III

10 Hours

Silos and Bunkers: Components, design using Janssen's Theory and IS: 456-2000 Method
Shell and folded plate roofs – Types, forms and structural behavior.

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

1.	Analyze slabs by yield line approach.
2.	Design flat slab by direct method.
3.	Analyze and design grid slabs by approximate methods.
4.	Design the continuous beams with moment redistribution.
5.	Analyze and design silos and bunkers and explain the behavior of shells

	and folded plates.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE203.1	2	2	3	1									2	2	
21CVE203.2	2	2	3	1									2	2	2
21CVE203.3	2	2	3	2									2	1	2
21CVE203.4	2	2	3	2									2	1	2
21CVE203.5	2	2		2							1		2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Raju N K "Advanced Reinforced Concrete Design", CBS Publisher
2.	Dr.B.C.Punmia et.al, "Reinforced Concrete Design",Vol – II, Lakshmi Publications

REFERENCE BOOKS:

1.	Jai Krishna and Jain "Plain and Reinforced Concrete Vol.II" Nem Chand Bros. Roorkee
2.	Varghese P.C "Advanced Reinforced Concrete Design" Prentice Hall of India – 2007
3.	Devadas Menon and Unnikrishnan.P "Reinforced Concrete Structures"
4.	Varghese.P.C. "Limit State Design of Reinforced Concrete Vol.II" Prentice Hall of India (P) ltd, New Delhi

E Books / MOOCs/ NPTEL

1.	
2.	
3.	

FINITE ELEMENT METHOD OF ANALYSIS

Course Code:	**21CVE204**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Get an idea how strain energy concept can be used for FEA method
2.	Analyse the components by 2D formulation and element discretization.
3.	Demonstrate numerical evaluation of stiffness to find stresses
4.	Study the concepts of Isometric and jacobian matrix.
5.	Finding solutions by numerical Integration.

UNIT-I

15 Hours

Finite element method, steps in finite element analysis, displacement approach, stiffness matrix and boundary conditions
Theory of elasticity concepts, Energy principles

UNIT-II

16 Hours

2D formulations; Constant Strain Triangle, Linear Strain Triangle, 4 and 8 noded quadrilateral elements, Numerical Evaluation of Element Stiffness -Computation of Stresses,
Finding solutions for Static Condensation of nodes

UNIT-III

09 Hours

Isoparametric concepts: isoparametric, sub parametric and super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Isoparametric Elements, Finding solutions to Numerical integration by Gaussian quadrature rule for one, two and three dimensional problems

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

1.	Explain the basic concept of energy principles and steps involved in FEA method and Analyze2D formulation for 4 and 8 noded quadrilateral elements.
2.	Determine static condensation of nodes.
3.	Analyze and Evaluate element stiffness and stresses by numerical approach.
4.	Explain Isoparametric concepts applying Jacobian transformation matrix and Stiffness Matrix.
5.	Analyze and Find solutions for one, two and three dimensional elements by Numerical integration.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE204.1	2	3											2	3	
21CVE204.2	2	3											2	3	
21CVE204.3	2	3											2	3	
21CVE204.4	2	3											2	3	
21CVE204.5	2	3											2	3	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Krishnamoorthy C.S., "Finite Element analysis" -Tata McGraw Hill, 2015
2.	Desai C &Abel J F.," Introduction to Finite element Method" , East West Press Pvt. Ltd.,2014
3.	Cook R D et.al., "Concepts and applications of Finite Element analysis ", John Wiley.2013

REFERENCE BOOKS:

1.	Daryl L Logan," A first course on Finite element Method " , Cengage Learning 2011
2.	Bathe K J - "Finite Element Procedures in Engineering analysis "- Prentice Hall .2016

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/112/104/112104193/
2.	https://nptel.ac.in/courses/112/104/112104116/

NUMERICAL METHODS IN CIVIL ENGINEERING

Course Code:	**21CVE205**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand different numerical techniques to solve civil engineering problems
2.	Understand different methods solving simultaneous and transcendental equations
3.	Understand various numerical integration techniques for computing slope and deflections of determinate beams
4.	Explain numerical methods for solving ordinary differential equations
5.	Explain finite difference techniques

UNIT-I

16 Hours

INTRODUCTION, SCOPE AND IMPORTANCE OF THE SUBJECT:

Solution of linear simultaneous equations by the following methods:

(i) Gaussian elimination, (ii) Gauss-Jordan matrix inversion, (iii) Gauss-Siedel, (iv) Factorization. Application of the above methods in solving problems by slope-deflection method applied to beams and frames, problems in construction planning.

Finding the roots of nonlinear algebraic and transcendental equations by (i) Bisection method, (ii) Newton-Raphson method. Application of the above methods to solve problems in structural engineering, hydraulics, geotechnical engineering and environmental engineering.

UNIT-II

15 Hours

NUMERICAL INTEGRATION TECHNIQUES: (i) Trapezoidal rule, (ii) Simpson's one third rule. Application of the above methods for computing the area of BMD for statically determinate beams. Computation of slope and deflection in statically determinate beams by New Marks method.

Solution of ordinary differential equations by (i) Euler's method, (ii) 4th order Runge-Kutta method. Application of the above methods to solve civil engineering problems.

UNIT-III

09 Hours

Finite difference techniques to solve problems in structural mechanics. Analysis of statically determinate and indeterminate beams,

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

1.	Develop the linear equations in solving problems related to Civil Engineering and solve them by different techniques
2.	Determine the Eigen values and Eigen roots for the given data.
3.	Find the area of bending moment diagram for different problems on statically determinate structures and computing slope and deflection of statically determinate structures by adopting numerical integration techniques
4.	Formulate and solve differential equations for Computation of slope and deflection
5.	Analyze the determinate and indeterminate beams using finite difference method

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE205.1	3	2		1									1	1	
21CVE205.2	3	2		1									1	1	
21CVE205.3	3	2		1									1	1	
21CVE205.4	3	2		1									1	1	
21CVE205.5	3	2		1									1	1	

1: Low 2: Medium 3: High	
TEXTBOOKS:	
1.	Chapra S.C. &R.P.Canale, "Numerical Methods for Engineers", McGraw Hill, 2014.
2.	N.Krishna Raju &K.U.Muthu, "Numerical Methods in Engineering Problems", MacMillan India Limited, 2005.
REFERENCE BOOKS:	
1.	Iqbal H.Khan&Q.Hassan, "Numerical Methods for Engineers and Scientists", Galgotia, New Delhi, 2010.
2.	Pallab Ghosh, "Numerical Methods using Computer Programs in C", Prentice Hall of India Private Limited, New Delhi, 2006.
3.	Schilling, "Numerical methods for Engineers using MATLAB and C", I Edition, Thomson Publications, 2009.
4.	S. Rajasekaran, "Numerical Methods in Science and Engineering- A Practical Approach", S. Chand and Company Limited, New Delhi, 2013.
E Books / MOOCs/ NPTEL	
1.	
2.	
3.	

PAVEMENT MATERIALS AND CONSTRUCTION

Course Code:	21CVE206	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Know the properties, requirements and uses of soil, aggregates, Bitumen and Tar in the construction of pavement.
2.	Understand the preparation, requirements and uses of Bituminous emulsions and cutbacks.
3.	Choose suitable aggregate mix and design bituminous mix as per specification.
4.	Know the various equipment used in the construction of pavement and their working principle.
5.	Understand the different steps involved in preparing sub-grade and tests used to check its quality.
6.	Know the specifications, construction methods and quality control checks used for different layers of flexible pavement.
7.	Know the specifications, construction methods and quality control checks used for cement concrete pavement.
8.	Describe the necessity and use of different types of joints in cement concrete

UNIT-I

16 Hours

Introduction to Pavements, Types, Comparison, Typical cross-sections, functions and requirements.

SOIL: Requirements, Classifications and tests on subgrade soil.

AGGREGATES: Origin, classification, requirements, properties and tests on road aggregates. Concepts of size and gradation, design gradation. Maximum aggregate size, aggregate blending to meet the specification using method of trials and Rothfutch's method.

BITUMEN AND TAR: Origin, preparation, properties and chemical constituents of Bitumen and Tar, Requirements for pavement construction.

BITUMINOUS EMULSIONS AND CUTBACKS: Types, preparation, characteristics, tests and uses in road construction. Adhesion of bituminous binders to road aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion.

BITUMINOUS MIXES: Mechanical properties, dense and open textured mixes, flexibility and brittleness (excluding Hveem stabilometer & Hubbar – field

tests). Bituminous mix design by Marshall method and specification using different criteria- voids in mineral aggregate, voids in total mix, density, flow, stability and voids filled with bitumen.

UNIT-II

15 Hours

EQUIPMENT IN HIGHWAY CONSTRUCTION: Different types of equipment for excavation, grading and compaction, their working principle, advantages and limitations. Equipment for the construction of bituminous and cement concrete pavement and stabilized soil road.

SUB GRADE: Earthwork grading, construction of embankments and cuts for roads. Preparation of sub grade, quality control tests.

FLEXIBLE PAVEMENTS: Introduction, Brief discussions on following: Interface treatment-Prime coat and tack coat, Penetration macadam, Built-up spray Grout, Bituminous Macadam and Dense Bituminous Macadam.

Specifications of materials, construction methods and quality control checks during construction for typical Wet mix Macadam base and Bituminous Concrete surface course as per BIS only.

Field quality control tests after the construction of flexible pavement: Specifications of materials, construction method and field control checks for different types of flexible pavement layers.

UNIT-III

09 Hours

CEMENT CONCRETE PAVEMENTS: Specifications of materials and method of construction of cement concrete pavements, Quality control tests.

Different types of joints used and their construction method.

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

1.	Explain the types of pavements, component layers, their functions, their importance, and the various materials used for the construction and to describe the properties, requirements, preparation and uses of soil, aggregates, Bitumen, Tar, bituminous emulsions and cutbacks in the construction of pavement.
2.	Select suitable aggregate mix and to design the bituminous mix as per Marshall Method.
3.	Select the suitable equipments for the construction of pavement based on necessity and describe their working principle; and describe the different steps involved in preparing sub-grade and tests used to check its quality.
4.	Recite the specifications, construction methods and quality control checks used for different layers of flexible pavement.

5.	Explain the specifications, construction methods and quality control checks used for cement concrete pavement and to construct the different types of joints in the pavements.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE206.1	3	2											2	2	
21CVE206.2	2	3	2										2	2	1
21CVE206.3	3	1											3	2	2
21CVE206.4	3	2	1										2	3	1
21CVE206.5	3	2	1										2	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kadiyali L. R., Lal. N.B, "Principles and Practices in Highway Engineering", Khanna Publishers, New Delhi. Revised Edition. 2012.
2.	Khanna. S. K, Justo. C.E.G, Veeraragavan. A, "Highway Engineering", Revised 10th edition, Nem Chand and Bros, 2014.

REFERENCE BOOKS:

1.	Sharma S K," Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd., New Delhi, 2006.
2.	Peurifoy R. L., (2003), "Construction Planning, Equipment and Methods", TMH, New-Delhi.
3.	F.L.Roberts. Prithvi S. Kandhal., E. Ray Brown, Dah-Yinn Lee, Thomas W. Kennedy, "Hot mix asphalt materials, mixture design, and construction", Second edition, National Asphalt Pavement Association Research and Education Foundation, Lanhman, Maryland, 1996.
4.	RRL, DSIR, "Bituminous Materials in Road Construction", HMSO Publication, London.
5.	Sharma, S. C., (2005), "Construction Equipment and its Management", Khanna Publishers, New Delhi, 110006.

E Books / MOOCs/ NPTEL

1.	

PAVEMENT DESIGN

Course Code:	**21CVE207**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Get a preliminary knowledge on flexible and rigid pavement design for highways and airport pavements.
2.	Analyze the stresses and deflections in flexible and rigid pavements.
3.	Understand the various methods in designing the structure of a flexible pavement.
4.	Describe the functions and requirements of various types of joints in CC pavement.
5.	Know to design the various component parts of concrete pavement.

UNIT-I

16 Hours

PAVEMENT DESIGN: Desirable characteristics and requirements of a well-designed Pavement, Difference between highway and air field pavements, Basic concepts and objects of pavement design. Functions of various components and comparison of flexible and rigid pavements, Factors affecting design and performance of pavements.

STRESSES AND DEFLECTIONS IN FLEXIBLE PAVEMENTS: Stresses and deflections, Principle-Assumptions-limitations, applications of Boussinesq's single layered theory and Burmister's two layered theories in pavement design and problems. Various factors in traffic design wheel load-Contact pressure-ESWL concept for dual and tandem wheel load assembly (Boyd and Foster method), repeated loads and EWL concept-Problems.

UNIT-II

15 Hours

FLEXIBLE PAVEMENT DESIGN: Methods for highways and airport pavement design, Introduction to CBR method-Advantages and limitations, Flexible pavement design as per IRC: 37-2001- design factors and recommendations- design steps and Problems.
McLeod method, Burmister's method and Kansas (triaxial) method- principle, design steps and problems.

STRESSES IN RIGID PAVEMENTS: Factors to be considered in traffic wheel load during the design life of a CC pavement. Basic principle and concepts in analysis of

stresses in rigid pavements. Westergaard's analysis- Assumptions, Modified Westergaard's (IRC) equations- Concept of Wheel load stresses-Warping stresses-Frictional stresses-Combined stresses (Using charts /equations)-Problems.

UNIT-III

09 Hours

RIGID PAVEMENT DESIGN: Types of joints in cement concrete pavements and their functions, joints details for longitudinal joints, contraction joints and expansion joints. Design of joint spacing as per IRC guidelines.

Design of Dowel bars at load transfer joints, Design of Tie bars at longitudinal joints-design steps and problems as per IRC: 58-2002. Design of low volume concrete roads by IRC equations method; Guidelines for thickness design of CC slab as perIRC:58-2002

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

1.	Explain the fundamental design factors affecting the performance of flexible and rigid pavements.
2.	Analyze the stresses and deflections in flexible pavement.
3.	Design the thickness of the highway and airport pavements by different methods.
4.	Compute the stresses and deflections in cement concrete pavements.
5.	Design various components of the rigid pavement as per IRC guidelines.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE207.1	3												1	3	
21CVE207.2	2	3	1										2	1	
21CVE207.3	3	2											1	2	1
21CVE207.4	2	3	1										2	1	
21CVE207.5	3	2											1	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Khanna. S. K, Justo. C.E.G, Veeraragavan. A, "Highway Engineering", Revised 10th edition, Nem Chand and Bros, 2014.
2.	Kadiyali L. R., Lal. N.B, "Principles and Practices in Highway Engineering", Khanna Publishers, New Delhi, 2014.
REFERENCE BOOKS:	
1.	Sharma S K," Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd., New Delhi, 2006.
2.	Khanna, Justo. C.E.G, "Highway Engineering", 8th edition, Nem Chand and Bros, 2001.
3.	Yoder E.J. and Witczak, "Principle of pavement design", 2nd edition, John Wiley and Sons, 1975.
4.	Yang H. Huang, "Pavement Analysis and Design", Pearson Prentice Hall, 2004
5.	Relevant IRC codes for the design.
E Books / MOOCs/ NPTEL	
1.	
2.	
3.	

REINFORCED EARTH STRUCTURES

Course Code:	**21CVE208**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Know the concepts of reinforced earth structures.
2.	Know the types, engineering properties of Geo synthetics
3.	Understand the field requirements of Geo synthetics for using them in Separation, filtration, drainage and containment
4.	Understand the principles and design of earth embankments.
5.	Understand the stability analysis of reinforced earth foundations and to know the concepts of Soil nailing system

UNIT-I — **15 Hours**

REINFORCED EARTH: Historical background, mechanism of reinforced earth, Effect of reinforcement on soil. Application and advantages of reinforced earth.

GEOSYNTHETICS: Types, properties and testing methods.

UNIT-II

16 Hours

COMPONENTS: Soil- properties; Reinforcement, types- geosynthetics and metallic (bars, strips, mats and grids). Facing elements-types and properties.

FUNCTIONSOF GEOSYNTHETICS: Separation, reinforcement, filtration, drainage and containment. *Two examples of application in the field (case histories) for each function are to be explained.*

REINFORCED EARTH RETAINING WALL**:** External and internal stability, Design Methods – Coherent gravity and Tie back wedge, design of typical reinforced earth retaining wall (Tieback wedge method only).

UNIT-III

09 Hours

REINFORCED EARTH EMBANKMENT AND FOUNDATION: Improving the stability of a typical earth embankment slope using geotextiles. Reinforced earth foundation – Modes of failure, improvement of bearing capacity by geotextile inclusion.

SOIL NAILING SYSTEM: concept and principles, driven and grouted nail system, advantages and limitations.

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

1.	**Describe** the mechanism and **list** advantages of reinforced earth.
2.	**Evaluate** physical, mechanical strength, hydraulic, durability and endurance properties for a given geosynthetics.
3.	**Explain** the components of reinforced earth, **outline** the functions of geotextile and **assess** the suitability of geosynthetics in filtration, drainage and containment.
4.	**Design** the reinforced earth retaining wall using Tieback wedge method for external and internal stability.
5.	**Analyze** and c**heck** the stability of reinforced earth embankments, earth foundations and recommend suitable measure to improve bearing capacity.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
													1	2	3
21CVE208.1	2	1	1			1							3	2	
21CVE208.2	3	1	1			1							3	2	
21CVE208.3	1	1	3			2	1	1					3	2	1
21CVE208.4	2	1	3			2	1	1					3	2	1
21CVE208.5	1	2	3			2	1	1					3	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Jones C.J.E.P, (1996), "Earth Reinforcement and Soil Structure", Butterworth's, London.
2.	Korner, R.M, (1999), "Design With Geo-synthetics", Prentice -Hall of India, Pvt. Ltd.New Delhi.

REFERENCE BOOKS:	
1.	Ingold, T.S.,(1989), "Reinforced Earth", Thomas, Telford, London
2.	Purushothama Raj, P. (2016), "Ground Improvement Techniques", Laxmi Publication(P) Ltd., Bangalore
3.	Venkatappa Rao G., and Suryanarayana Raju, G.V, S.,(1990), "Engineering With Geosynthetics", TataMcGraw Hill Publishing Company Limited, NewDelhi.
4.	Swamy Saran, (2005), "Reinforced Soil and Its Engineering Applications", I. K. International Publishing House Pvt Ltd.
E Books / MOOCs/ NPTEL	
1.	http://nptel.ac.in/courses/105106052/9
2.	http://nptel.ac.in/downloads/105101083/

DEEP FOUNDATIONS

Course Code:	**21CVE209**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To learn more about the introductory aspects of piles, selection of deep foundation systems and associated equipment.
2.	Design of axial and lateral geotechnical capacity of driven piles in both individually and as group and Learn the usage of wave equation analysis applied to the design and installation of driven piles including driving problem.
3.	To carry out the design of pile and to estimate the efficiency of a Pile Group.
4.	To understand the structural mechanic aspects of the design in a laterally loaded pile and to estimate the ultimate resistance of a laterally loaded pile.
5.	Study the different types of well foundations and carry out the analysis and design.

UNIT-I

16 Hours

PILE CLASSIFICATION

Function – classification of piles – Factors governing choice of pile foundation – Load transfer principles – *piling equipment and methods* – changes in soil condition during installation of piles –Load transfer mechanism,

Soil properties for static pile capacity, Ultimate static pile point capacity, Skin resistance, Static load capacity using load transfer, *Tension piles, Piles for resisting uplift, Laterally loaded piles,* Numerical problems. *Pile load test and Penetration tests.*

Single pile –Dynamic analysis and load tests: Dynamic analysis, Pile driving, Rational pile formulae, other dynamic pile driving formulae and general considerations, Reliability of dynamic pile driving formulae.

UNIT-II

15 Hours

Pile groups – Efficiency of pile groups- Group capacity in clays– Minimum spacing of piles in a group – Negative skin friction of single piles and pile groups –Settlement of pile groups in clays – Equivalent raft approach – Settlement of pile groups in sands, *under reamed piles*.

UNIT-III

09 Hours

WELL FOUNDATIONS

Components of a well foundation–Procedure for construction and sinking of wells–Thickness of well steining for sinking under self-weight - Grip length- Problems encountered in well sinking–Tilts and Shifts– Causes – Permissible tilts and shifts - Methods to rectify tilts and shifts – Forces acting on a well foundation –Allowable bearing pressure – Lateral stability of well foundations - Terzaghi's analysis.

Drilled Piers & Caissons

Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. *Advantages and disadvantages of floating caissons.*

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

1.	**Understand** about the introductory aspects of piles and Selection of deep foundation systems and associated equipment.
2.	**Analyze and design** individually loaded piles using static and dynamic formula's.
3.	**Analyze and design** pile group and estimate the efficiency of a Pile Group.
4.	**Understand** and Estimate the settlement of pile group under loading.
5.	**Analyze and Design** the types of well foundations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE209.1	1	1											1	3	1
21CVE209.2	1	2	3										2	3	
21CVE209.3	1	2	3										2	3	1
21CVE209.4	1	2	3										2	3	1
21CVE209.5	1	2	2										2	3	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
2.	Swami Saran" Analysis and Design of Substructures Limit state design", Oxford and IBH Pub. Co.pvt, Ltd. New Delhi 1996.

3.	Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.
4.	Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995.
REFERENCE BOOKS:	
1.	Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
2.	Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 1996.
3.	Donald, P., Coduto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996.
4.	Winterkorn, H.F. and Fang, H.Y, Foundation Engineering Handbook, Von Nostrand Reinhold, 1994.
5.	Grigorian, Pile Foundation for Buildings and Structures in collapsible Soil, Oxford & IBH Publishing Co, Pvt. Ltd., New Delhi, 1999.
6.	Varghese P.C.," Foundation Engineering", PHI Learning Private Limited, New Delhi, 2005.
7.	Code of practice for design and construction of pile foundation-IS:2911 (Part I to IV).
8.	Shamsher Prakash and Hari D. Sharma "Pile foundations in engineering practice, wiley (2012).
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/105/108/105108069/
2.	https://nptel.ac.in/courses/105/105/105105039/
3.	https://nptel.ac.in/courses/105/106/105106144/

ENVIRONMENTAL GEOTECHNICS

Course Code:	21CVE210	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	To acquire knowledge about various branches of environmental geotechniques
2.	To familiarize with design of landfill impoundments
3.	To study different waste disposal systems suiting for hazardous and non-hazardous wastes
4.	To familiarize with non-destructive techniques of site characterization.
5.	To study the remediation methods for contaminated soil

UNIT-I

16 Hours

Introduction and Soil-water-environment interaction : Introduction to geoenvironmental Engineering, Soil-water-environment interaction relating to geotechnical problems, Waste:-source, classification and management of waste, Physical, chemical and geotechnical characterization of municipal solid waste, Impact of waste dump and its remediation.

Origin, nature and distribution of soil - Description of individual particle - Soil fabric and Geotechnical application of waste and disposal: Geotechnical use of different types such as Thermal power plant waste, MSW, mine waste, industrial waste. Waste disposal facilities, Parameters controlling the selection of site for sanitary and industrial landfill. Site characterization. MoEF guidelines.

UNIT-II

15 Hours

Sources, types and composition of different wastes - Characteristics and classification of hazardous wastes - Generation rates - Potential problems in soils due to contaminants.

Ground water flow - Sources of ground water contamination - Contaminant transport - Pollution of aquifers by mining and liquid wastes - Ground water pollution downstream of landfills - Transport mechanisms.

CPCB rules and regulations on waste handling and management - Criteria for selection of sites for waste disposal - Disposal techniques -Disposal systems for typical wastes.

Ground modification and waste modification techniques in waste management - Ground modification - Mechanical modification, hydraulic modification, chemical

modification.

UNIT-III

09 Hours

Liners and covers for waste disposal - rigid and flexible liners - Leachate and gas collection system - Engineered landfills (including basal liner and cover liner systems) – components - design criteria.

Hydrological design for ground water pollution control.

Soil contamination and remediation technology for both ground and aquifers.

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

1.	**Understand** the fundamentals, and engineering aspects on soil-water-environment interaction.
2.	**Explain** the Origin, distribution, and applications of solid waste management.
3.	**Classify and characterize** the hazardous waste and ground water flow of contaminant in soil.
4.	**Understand** CPCB rules and regulations on waste and **Examine** ground modification techniques in waste management.
5.	**Explain** the importance of liners, covers, hydrological designs and remediation's for soil contaminations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE210.1	1	2	1	1		2	2	1		2		2	1	2	
21CVE210.2	1	2	1	1		2	2	1		2		2	1	2	
21CVE210.3	1	2	1	1		2	2	1		2		2	1	2	
21CVE210.4	1	2	1	1		2	2	1		2		2	1	2	
21CVE210.5	1	2	1	1		2	2	1		2		2	1	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Koerner, R.M. (2005). Designing with Geosynthetics. Fifth Edition. Prentice Hall, New Jersey, 2005.

2.	Daniel, D.E. (1993). Geotechnical Practice for Waste Disposal.Chapman and Hall, London .
3.	K. R. Reddyand H D Sharma, "Geoenvironmental Engineering: Site Remediation, waste containment, and emerging waste management technologies", John Willey, 2004.
REFERENCE BOOKS:	
1.	David. E. Daniel, Geotechnical practice for waste disposal – Chapman and Hall – London, 1993.
2.	Masashi Kamon, editor – Balkema, Environmental Geotechnics, - Rotterdan 1996 3. Hsai- Yang Fang, 3. 3. Introduction to Environmental Geotechnology,- CRC Press, New York, 2009.
3.	Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
4.	Mitchell J. "Fundamentals of soil behaviour", John Wiley and Sons., Third Edition, 2005.
5.	Robert M. Koerner, "Construction and Geotechnical methods in Foundation Engineering", McGraw Hill Book Co., 1996.
6.	Abdel M. O. Mohamed and Hogan E. Antia, "Developments in Geotechnical Engineering", Elsevier, 1998.
7.	Hari D. Sharma and Krishna R. Reddy, "Geoenvironmental Engineering – Site Remediation, Waste Containment, Emerging waste management technologies", John Wiley and sons, 2004.
8.	Hsai Yang Fang and John Daniel, "Introduction to Environmental Geotechnology", CRC press, Taylor and Francis, Second Edition, 2013.
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/105/101/105101196/
2.	
3.	

DESIGN OF SPECIAL CONCRETES

Course Code:	**21CVE211**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Learn to differentiate and apply the principles of special concretes mix designs.
2.	Understand the materials, properties, applications, factors influencing the manufacturing of special concretes.

UNIT-I

16 Hours

SUSTAINABLE CONCRETE MIX DESIGN
Properties and factors to be considered for the use of industrial wastes, recycled wastes as aggregates in concrete, Design of Standard Grade Concrete with/without recycled and industrial waste aggregates, **Fiber Reinforced Concrete** – Properties, Applications, Factors influencing the mix design, Design of mixes.

UNIT-II

15 Hours

LIGHT AND HEAVY WEIGHT CONCRETE: Material, Properties, Applications, Factors affecting the mix design, Design of Mix Proportioning**,** Manufacturing Methods.

UNIT-III

10 Hours

MASS CONCRETE AND HIGH VOLUME FLYASH (HVFA) CONCRETE: Factors affecting the mix design, Mix proportioning

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

1.	**Identify** the Properties, factors influencing for the use of recycled, industrial waste aggregates in concrete and explain the properties, applications and factors influencing high strength and fiber reinforced concrete mixes.
2.	**Design** Standard, High Strength and Fiber Reinforced Concrete Mixes.
3.	**Identify** material, properties, applications, and explain the factors affecting the mix design, Manufacturing Methods of Light weight and high-density concrete mixes.
4.	**Design** Light weight and High-Density Concrete mixes.
5.	**Design** Mix Proportioning of Mass Concrete and High-Volume Fly Ash Concrete.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
													1	2	3
21CVE211.1	1	1					2							2	1
21CVE211.2	3	2	3	1			3	2				1	3	2	2
21CVE211.3	2	1					1							2	1
21CVE211.4	3	2	3	1			2					1	3	2	1
21CVE211.5	3	2	3	1			3					1	3	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	IS: 10262: 2019 - Concrete Mix Proportioning – Guidelines
2.	IS 456: 2000- reaffirmed in 2016: Plain and Reinforced Concrete - Code of Practice
3.	IS 383 : 2016 'Coarse and fine aggregates for concrete'

REFERENCE BOOKS:

1.	A.R. Santhakumar, "Concrete Technology"-Oxford University Press, New Delhi, 2015.
2.	Short A and Kinniburgh. W, "Light Weight Concrete"- Asia Publishing House, 2000
3.	Neville A.M, "**Properties of Concrete",** Pearson Education, Asis, 2012.
4.	Aitcin P.C. "High performance concrete"-E and FN, Spon London 1998

E Books / MOOCs/ NPTEL

1.	
2.	
3.	

SUSTAINABLE CONSTRUCTION MATERIALS AND METHODS

Course Code:	**21CVE212**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the 'modern' building materials developed using advanced technologies and testing methods.
2.	Apprehend the application of recycled/reconstructed building materials in the construction of green buildings.
3.	Know the different precast construction methods used at construction site.
4.	Appreciate the cutting-edge technologies, methods and strategies of project management for sustainable construction.
5.	Comprehend components of embodied energy in building and understand the Rating Systems, its contribution to sustainability based on GRIHA and LEED Rating systems.

UNIT-I

16 Hours

Modern Building Materials: Properties and applications –Self-healing concrete3D graphene, Self-healing concrete, Aerographite, Laminated timber, Modular bamboo, Transparent aluminium, Translucent wood, Light-generating concrete, Microbial cellulose, Spider silk, Aluminium foam, Nanocrystal, Wool brick, Pollution-absorbing brick, Hydroceramics, Biochar, Bioreactors, Invisible solar cells

Modern Construction Formworks: Aluminium formwork, Precast system, Modular formwork, Tunnel formwork, Fiberglass shuttering.

UNIT-II

15 Hours

Modern Building Construction Techniques: 3D Volumetric Construction, Precast Flat Panel Modules, Pre-cast Foundation Technique, Hybrid Concrete Building Technique, Thin Joint Masonry Technique, Insulating Concrete Formwork (ICF) Technique

Sustainable Construction and Management: Identification of cutting edge sustainable construction materials, technologies. Project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.

UNIT-III

10 Hours

Components of Embodied Energy: energy for production, transportation and erection, Estimation methodology, Computation of embodied energy for building. **Green Buildings Rating**: Concepts Features of TERI GRIHA rating. LEED rating with respect to building envelope, Economics of sustainability and benefits

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

1.	**Explain** the properties and applications of modern building materials.
2.	**Describe** the choice, properties and various applications of modern construction formworks.
3.	**Describe** advanced construction techniques.
4.	**Identify** the cutting-edge technologies, methods, strategies of project management
5.	**Explain, compute the components of embodied energy** and **evaluate** a building based on GRIHA and LEED rating systems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE212.1	1	2				1	2						1	2	
21CVE212.2	1	2				1	2						1	2	
21CVE212.3	1	2				1	2						1	2	
21CVE212.4	1	2			2	1	2						1	2	
21CVE212.5	1	3			2	1	3	2					1	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Bureau of Indian Standards – relevant codes.

2.	National Building Code of India -2016
3.	Product Manufacturers' manuals/specifications
REFERENCE BOOKS:	
1.	CPWD construction manual - 2019
2.	Sustainability of Construction Materials, Woodhead Publishing Series in Civil and Structural Engineering Edited by J. Khatib - 2nd edition-2016.
3.	Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010
4.	GRIHA MANUAL VOL I "National Rating System for Green Buildings, Green Rating for Integrated Habitat Assessment (GRIHA)", Ministry of New & Renewable Energy Government of India, Teri Press, 2010
5.	GREEN BUILDING GUIDE Design Techniques, Construction Practices & Materials for Affordable Housing, Published by Rural CommUNITy Assistance Corporation (RCAC), by Craig Nielson, LEED AP, 2019.
6.	IGBC Green Building Ratings System Version 3.0 – Abridged Reference Guide September – 2014.
7.	Wu Chung, H. Advanced Civil Infrastructure Materials, First Edition, Woodhead Publishing Limited, 2006
8.	Ministry of Power, Energy Conservation Building Code 2007, Revised Version, Bureau of Energy Efficiency, 2008,
9.	Indian Building Congress, Practical Handbook on Energy Conservation in Buildings, 1st ed. Nabhi Publication, 2008.
10.	TERI-Griha's Green Design practices (www.teriin.org/bcsd/griha/griha.htm)
11.	Leadership in Energy and Environmental Design (www.usgbc.org/LEED)
12.	Venkatarama Reddy, B. V., and. Jagadish, K., S. "Embodied energy of common and
13.	Alternative building materials and technologies". Energy and Buildings., 35, 129-137,2003
E Books / MOOCs/ NPTEL	

1.	
2.	
3.	

VALUATION OF REAL PROPERTIES

Course Code:	21CVE213	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Classify properties and understand forms of value.
2.	Determine depreciation using suitable methods.
3.	Apply techniques of valuation of land.
4.	Understand forms of rent and determine standard rent.
5.	Adopt suitable techniques of valuation of lands with buildings.

UNIT-I

16 Hours

Cost, Price and Value, Nature and essential characteristics of value. Forms of value. Valuation and its purpose. Classification of property- Freehold and leasehold. Sinking Fund. Amortization. Depreciation and Obsolescence. Methods of depreciation - Straight Line Method, Constant Percentage Method, Sum of years digit method, Sinking Fund Method and Declining Balance Method.

Qualities of a valuer, Principal types of lease- Building lease, Occupation lease, Sublease, Life lease, Perpetual lease.

UNIT-II

15 Hours

Valuation of Land - Valuation methods: Comparative Method, Abstractive Method, Belting Method, Development Method, Flat Rate Technique and Hypothetical Building Scheme (or Land residual Method.) Rent and forms of rent - Outgoings, Gross income and net income, Year's purchase, rate of interest, Standard rent and its computation, Tenancy Laws on rent.

Factors affecting the value of Land, Regular Shaped Plots, Land Locked Land, Recess Land, Strips of Land, Estimating the future life of buildings.

UNIT-III

09 Hours

Valuation of Land with Buildings: Direct Comparison, Land and building method, Rental Method, Profit Method, Development Method, - Valuation for Capital Gains, -, Valuation for Land Acquisition.

The Real Estate (Regulation and Development) Act 2016, Insolvency and Bankruptcy Code.

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

1.	**Identify** forms of value and classify property.
2.	**Determine** depreciation rates for properties.
3.	**Make use of** suitable method to **valuate** a land.
4.	**Determine** standard rent of a property.
5.	**Valuate** a property with land and building and **make use of** RERA to appropriate condition.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE213.1	1														3
21CVE213.2	2												2		
21CVE213.3	2	2													3
21CVE213.4	1												2		
21CVE213.5	2	2													3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Namavati, R., (1991), "Theory and Practice of Valuation", Lakhani Book Depot, Mumbai
2.	S.C. Rangwala, "Valuation of Real Properties" Charotar Publishing House Pvt ltd , Anand. Ninth edition (2013).
3.	ShyamalesDutta , "Valuation of Real Property" Eastern Law House, Kolkata Second edition (2004)

REFERENCE BOOKS:

1.	S.C. Rangwala , "Elements of Estimating and Costing", Charotar Publishing House, Anand. (1984),
2.	Sabapathy, B.K., (1996), "Practical Valuation", Ezhilarasi Prestige Flats, Tiruchirapalli.

E Books / MOOCs/ NPTEL

1.	
2.	
3.	

DISASTER MANAGEMENT AND MITIGATION

Course Code:	21CVE214	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Describe the basic types of hazards and their potential consequences to India
2.	Understand the planning and assessment of Hazard, Risk, Vulnerability and disaster
3.	Describe the basic concepts of the emergency management cycle (mitigation, preparedness, response, and recovery)
4.	Critically understand the various disaster management acts and policies and approaches in both national and state level scenario.
5.	To build skills to respond to disasters in an effective, humane and sustainable manner

UNIT-I

16 Hours

Hazard, Risk, Vulnerability, Disaster and Disaster Management. Types of Disasters: Hazard and vulnerability profile of India.

Relevance of Disaster Risk, Vulnerability & Capacity Assessment in Planning, Concepts of Hazard Assessment, Vulnerability Assessment, Risk Assessment and Capacity Assessment, Hazard Identification and analysis.

UNIT-II

15 Hours

Four elements of comprehensive disaster management (Preparedness, Response, Recovery and Mitigation), Concept of Mitigation and its importance (Structural and Non Structural mitigation measures, identification of mitigation measures relating to different types of hazards and implementing strategies). Land use Management tools for disaster risk reduction. (building codes, GDCR, zoning ordinances, land acquisition, transfer of development rights, Recovery and reconstruction plan).

National Disaster Management Act, Various State Disaster Management Acts (Gujarat, Uttar Pradesh, Uttaranchal, Bihar, Karnataka) and State disaster management policies (e.g. Orissa, Gujarat, Uttaranchal, Karnataka, Tamil Nadu, Delhi, Uttar Pradesh). Relevance of Rehabilitation and Resettlement Policy in Recovery and reconstruction phase of

disaster management. Coastal zoning regulation for construction and reconstruction phase in the coastal areas.

UNIT-III

09 Hours

Role of Government/Civil Society/International Organizations/CommUNITies and Approaches to CommUNITy Based Disaster Risk Management and Planning. (Local coping mechanisms, Importance of Mock Drills and On site volunteer management in CommUNITy level disaster preparedness activities).

Projects implemented general description of projects carried out in India following natural disasters. Disaster resistant buildings & measures. Recent developments. Case studies

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

1.	Develop an understanding of the key concepts, definitions a key perspective of All Hazards, Disasters, Risk and Vulnerability
2.	Develop a deep understanding of disaster resilience, risk mitigation, and recovery policies as they arise from natural hazards around the globe
3.	Develop a basic under understanding of Prevention, Mitigation, Preparedness, Response and Recovery
4.	Understand the various acts and policies related to Indian disaster management
5.	Explain the role of public and private partnerships

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE214.1															
21CVE214.2															
21CVE214.3															
21CVE214.4															
21CVE214.5															

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Emergency Management: A Reference Handbook by Jeffrey B. BumgarnerABC-Clio, 2008
2.	Lessons of Disaster: Policy Change after Catastrophic Events by Thomas A. BirklandGeorgetown University Press, 2006
3.	The Indian Ocean Tsunami: The Global Response to a Natural Disaster by Pradyumna P. Karan; Shanmugam P. SubbiahUniversity Press of Kentucky, 2011
REFERENCE BOOKS:	
1.	Chaos Organization and Disaster Management by Alan KrischenbaumMarcel Dekker, 2004
2.	Emergency Relief Operations by Kevin M. CahillFordham University Press, 2003
3.	A Comprehensive Approach to Emergency Planning By Worsely, Tracy L.; Beckering, DonCollege and University, Vol. 82, No. 4, January 1, 2007.
E Books / MOOCs/ NPTEL	
1.	
2.	
3.	

CONSTRUCTION SAFETY MANAGEMENT

Course Code:	**21CVE215**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Outline the salient feature of safety programs for construction.
2.	Summarize the Indian standards for safety in construction.
3.	Summarize the construction accidents and safety measures.
4.	Explain the behaviour of fuels during fire accidents.
5.	Outline the importance of housekeeping and explain the common hazards.

UNIT-I

16 Hours

Safety Management - Introduction, salient features of safety programs, general safety programs for construction. Safe working environment, Safety clauses in contract documents, Safety programme, Safety policy, Safety department, *safety officers, safety records, safety training*. Safety lacunae in Indian Construction Industry

SAFETY STANDARDS - Indian standards for safety in construction, *BIS standards*, American National Standards**.**

UNIT-II

15 Hours

CONSTRUCTION ACCIDENTS AND SAFETY - Accident- Causes, Effects and Safety measures, Legal requirements, Responsibility of the employers. Reporting occurrence of accidents, Reporting occurrence of hazards, *Action to be taken by the Site-in-charge in case of accidents.*

FIRE PREVENTION AND CONTROL - Understanding fire chemistry, Behaviour of fuels in fire, *Fire causes, Types of extinguishers and use,* Fire prevention planning, Check list for fire prevention. Emergency Escape Means of Escape, Evacuation, Occupant firefighting.

UNIT-III

09 Hours

COMMON HAZARDS - Dust, Impregnated timber, Lead poisoning, Toxic fumes, Noise, *Code of practice for reducing noise, Vibration, Power supply*, Lighting, Maintenance, House-keeping, Materials, Movement, Drowning, Openings, Weight.

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

1.	**Explain** the salient features of safety programs in construction.
2.	**Summarize** the Indian standards for safety in construction.
3.	**Outline** the construction accidents and its safety measures.
4.	**Explain** the behaviour of fuels and fire chemistry during fire accidents.
5.	**Outline** the importance of housekeeping **and** explain the common hazards.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE215.1	2							2					2		
21CVE215.2	2							3					2	2	
21CVE215.3	2											2	2	2	
21CVE215.4	2											2	2	2	
21CVE215.5	2											2	2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Construction Safety Management, NICMAR Publications, Hyderabad, October 2003.

REFERENCE BOOKS:

1.	Jimmy W. Hinze, construction safety, Prentice hall Inc 1997
2.	Richard.J.Coble, Jimmoe and TheoeHampt, Construction Safety and Health Management, Prentice Hall Inc 2001.

E Books / MOOCs/ NPTEL

1.	
2.	
3.	

CONSTRUCTION ECONOMICS AND FINANCE

Course Code:	**21CVE216**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Define the importance of engineering economics
2.	Summarize the scope of engineering economics and elements of cost in economy
3.	Outline the role of civil engineering in construction economics and its effects on workers.
4.	Summarize the capital structure in financial management
5.	Explain the fund flow and cash flow statements to implement in construction accounting.

UNIT-I

16 Hours

INTRODUCTION TO ECONOMICS - Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency

Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, OpportUNITy cost, Break-even analysis.

UNIT-II

15 Hours

CONSTRUCTION ECONOMICS - Role of Civil Engineering in Industrial Development, Construction development in Housing, transport and other infrastructures, Economics of ecology, environment, energy resources. Construction workers - Urban Problems, Poverty, Unemployment Effects on economics due to migration of construction workers to urban area

Capital Structure - The need for financial management, Types of financing - short term borrowing, long term borrowing, leasing.

UNIT-III

09 Hours

FINANCIAL ANALYSIS - Fund Flow and Cash Flow statements (Simple Problems), Financial Analysis – Meaning and Types, Tools and Techniques, Ratio Analysis, Types of Ratios, Profitability Ratio, Turnover ratio, Financial ratio (Balance sheet ratios) (Simple problems), Liquidity and Profitability.

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

1.	**Outline** the importance of engineering economics.
2.	**Explain** the scope of engineering economics and **outline** the elements of cost**.**
3.	**Explain** the role of civil engineering in construction economics and **identify** its effect on construction workers.
4.	**Explain** the capital structure in financial management.
5.	**Prepare** fund flow and cash flow statements and **utilize** in construction accounting.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE216.1	2												2		
21CVE216.2	2												2	2	
21CVE216.3	2	1				2	2					2	2	2	
21CVE216.4	2	1										2	2	2	
21CVE216.5	2	2										2	2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2012.
2.	Suma Damodaran, "Managerial economics", Oxford university press 2010.
3.	I.M. Pandey, "Financial Management" 11th edition, VikasPublishing house Pvt, Ltd, 2015.

REFERENCE BOOKS:

1.	Warneer Z Hirsch, "Urban Economics", Macmillan, New York.
2.	Prof. K.S. Nagapathi "Management Accounting", R. Chand & Co., New Delhi.

E Books / MOOCs/ NPTEL

1.	
2.	
3.	

Finance Management

Course Code:	21CVE217	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the Nature and Purpose of Business, Financial Markets and Instruments
2.	Apprehend Financial Institutions and Investment Banking
3.	Appreciate the models of micro finance and its operational aspects.
4.	Comprehend components of microfinance, disaster and insurance fundamentals.
5.	Know the basics of role and functions of capital markets

UNIT-I

16 Hours

Nature and Purpose of Business

Economic activities – Types; Business - Characteristics and Objectives of Business, Structure of Business, Classification of Business activities, Classification of Industries, Business Environment.

Financial Markets and Instruments

Money Market - Capital Market – Primary Market and Secondary Market – derivatives. Market – Debt Market – Corporate Debt and Government Securities - New Financial Instruments.

Financial Institutions

Development Financial Institutions – Banking and Non-Banking Institutions – Mutual Fund Organizations – Insurance Companies

Investment Banking

Financial and economic meaning of Investment – Characteristics and objectives of Investment – Types of Investment – Investment alternatives – Choice and Evaluation

UNIT-II

15 Hours

Models of Microfinance

Models of Microfinance across the world, Microfinance delivery methodologies, Legal and Regulatory framework, Financial Inclusion, Impact of Microfinance

Microfinance: Operational Aspects

Financial products and services, financial accounting and reporting, Revenue models of Microfinance, Risk management.

Microfinance and Disaster

Recent developments of Microfinance in India, Microfinance and Disaster, Cases on Women SHGs, Linkage Building and Successful Micro Entrepreneurs

Fundamentals of Insurance*: I*ntroduction to Insurance, Principles of Insurance, Insurance contract and provisions

UNIT-III

08 Hours

Role and Functions of Capital Markets, SEBI

Overview of Capital Market; Stock Exchange; Commonly used Terms; Types of Capital Issues; Financial Products/ Instruments including ASBA, QIP; SEBI; Registration of Stock Brokers, Sub-brokers, Share Transfer Agents, etc. QIBs.

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

1.	**Explain** the *Nature and Purpose of Business and financial Markets and Instruments*.
2.	**Describe** *Financial Institutions and Investment Banking.*
3.	**Describe** *Financial Institutions and Investment Banking*.
4.	**Identify** models of micro finance and its operational aspects
5.	**Explain** role and functions of capital markets

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE217.1		2	1			2		1	1		3	1			
21CVE217.2		2	1			2		1	1		3	1			
21CVE217.3		2	1			2		1	1		3	1			
21CVE217.4		2	1			2		1	1		3	1			
21CVE217.5		2	1			2		1	1		3	1			

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Financial Institutions and Markets: Structure, Growth & Innovation , 6th Edition, 2017, by Bhole, McGraw Hill
2.	Financial Institutions and Markets,10 th edition,2014, by Jeff Madura , Cengage Learning
3.	Financial Institutions and Markets,10 th edition,2014, by Jeff Madura , Cengage Learning
REFERENCE BOOKS:	
1.	Microfinance in India, 2008, K G Karmakar, SAGE Publications
2.	Capital Markets of IndiaAn Investor's Guide, 2011, By Alan R. Kanuk · Wiley publisher
E Books / MOOCs/ NPTEL	
1.	
2.	
3.	

SOLID WASTE MANAGEMENT

Course Code:	**21CVE218**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Impart the knowledge of present methods of solid waste management system and to analyze the drawbacks
2.	Understand various waste management statutory rules for the present system
3.	Analyze different elements of solid waste management and design and develop recycling options for biodegradable waste by composting.
4.	Identify incineration technologies and waste to energy incineration methods
5.	Identify hazardous waste, e-waste, plastic waste and bio medical waste and their management systems.

UNIT-I

16 Hours

Introduction: *Scope and importance of solid waste management*, definition and functional elements of solid waste management,

Sources: Sources and types of solid waste, composition of municipal solid waste, generation rate and conventional solid waste disposal methods.

Collection and transportation of municipal solid waste: services, systems and economics, Municipal Solid waste (Management and Handling) 2016 rules.

Composting: *Aerobic and anaerobic process, Vermicomposting.*

Sanitary land filling: definition, site selection, methods, stages, leachate movement and control, advantages and disadvantages.

UNIT-II

15 Hours

Incineration, Air emission control and Energy Recovery:

Types of incinerators, air pollution control process sources – air pollutants and their effect on health and environment. Air pollution control strategy – particulate and gaseous pollution control devices, types of waste to energy technologies.

Hazardous waste management: Definition, identification, classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, hazardous waste management rules 2016(India).

E-waste management: Definition,categories, impacts on human health and environment, recycling and recovery an integrated approach, e-waste generation and management status in India, E-waste management rules

2016(India).

UNIT-III

09 Hours

Biomedical waste management: Classification, collection, transportation, disposal and treatment of biomedical waste, biomedical waste management rules 2016(India).

Plastic waste management: Sources, types, uses, impact of plastics on marine life, effect on wildlife, human health and environment. *Practices- use of plastic waste in roads, greener alternatives.* Plastic waste management rules 2016(India).

Construction and demolition waste management: origin, components, proper management, recycling, construction and demolition waste management rules.

Government initiatives for solid waste management: Swatch Bharat Mission, Smart City.

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

1.	**Explain** the basic engineering principles of solid waste management, **identify** improper practices and **summarize** the environmental implications.
2.	**Outline** the need for economics in collection and transportation of solid waste and **select** the collection and disposal systems.
3.	**Explain** the process of incineration, energy recovery and **illustrate** the environmental impacts of incineration.
4.	**Plan** the transportation protocol for hazardous wastes, e-waste and choose the treatment and disposal methods.
5.	**Develop** an idea on conventional handling and treatment options for biomedical, plastic, construction and demolition waste and **discuss** government initiatives for waste management.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
													1	2	3
21CVE218.1	1	2				2	3	2					1	3	
21CVE218.2	1	1	2			2	3	2					1	3	
21CVE218.3	2	1				2	3	2					1	3	
21CVE218.4	2	1				2	3	2					1	3	
21CVE218.5	1	1				2	3	2					1	3	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	George. C. Tchobanoglous, "Integrated Solid Waste Management" – McGraw hill publication. International edition 1993, ISBN 978-0070632370
2.	Bhide A D and Sunderashan B B, "Solid Waste Management in developing countries", Indian National Scientific Documentation Centre, 1983

REFERENCE BOOKS:

1.	R.E. Hester, Roy M Harrison, "Electronic waste management", Cambridge, UK, RSC Publication, 2009, ISBN 9780854041121
2.	Municipal Solid waste (Management & Handling Rules) , Ministry of Environment & Forest Notification, New Delhi, 25th Sept 2000 and amendments on 2013.
3.	The Plastic Manufacture, Sale and usage Rules2009. Ministry of Environment and Forest Notification, New Delhi, amendment on February 4, 2011
4.	Biomedical waste management (Management & Handling Rules) 20th July 1998. Ministry of Environment & Forest Notification, New Delhi, amendment on February 26,2013.
5.	Ashok K. Rathoure "Zero Waste: Management Practices for Environmental Sustainability "ISBN: 9780367180393, 2019
6.	swachhbharaturban.gov.in; http://swachhbharatmission.gov.in/sbmcms/index.htm
7.	http://smartcities.gov.in/content/

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/120/108/120108005/
2.	https://nptel.ac.in/courses/105/105/105105160/
3.	https://nptel.ac.in/courses/105/106/105106056/

ADVANCED APPLIED ENGINEERING GEOLOGY

Course Code:	**21CVE219**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	**Develop an understanding** and **appraise** the significance of Earth Sciences in Civil Engineering practices.
2.	**Identify** and **differentiate** the suitable Materials of construction **evaluating** its Engineering properties
3.	**Appraise and appreciate** the advanced applications of Earth Sciences in the field of resource exploration, natural calamities, health and environmental management.
4.	**Identify, Appreciate, Analyse, Interpret, Evaluate** and **Solve** the geological problems coming under Civil Engineering practices

UNIT-I

15 Hours

Geology and Engineering: Earth Science and its disciplines in Engineering practices, Geological Engineering, significance of geology in the Civil Engineering projects, Maps and Map Reading

Earth Resources and Applied Geology: Geology of dams, reservoirs, tunnels, highways and bridge site engineering. Engineering Properties of Rocks: Crushing strength, Transverse strength, porosity, density, abrasive resistance, frost and fire resistance, Qualities of good Building stones, Road Metals, Railway Ballasts & Concrete aggregates. Rocks as M.O.C. – foundation, decorative stones, flooring & roofing with examples.

UNIT-II

16 Hours

Geohydrology and Watershed Management: Concept of watershed and its development, rainwater harvesting & artificial recharging, water quality and water pollution

Environmental Geology & Medical Geology: Earth and Health, Impact of Geology on environmental health hazards, Environmental Geology of landslides, mining, developmental projects, etc., its applications in Engineering disciplines and civil engineering projects viz: tunneling, dams and reservoirs, etc., Impact of Weathering and Erosion in the Civil Engineering projects and structures

UNIT-III

	09 Hours

Exploration Geology and Geophysics: for foundation and groundwater; geological, geophysical and hydrological investigations, electrical resistivity and seismic methods, Remote Sensing, GIS, GNSS and their application in the field of exploration and civil engineering

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

1.	**Identify, Explain** and **Appraise** the significance of Earth Sciences in Civil Engineering practices.
2.	**Identify** and **differentiate** the suitable materials of construction **evaluating** its Engineering properties
3.	**Identify** and **appraise** artificial recharging, water quality, watershed development and management.
4.	**Appraise and appreciate** the advanced applications of Earth Sciences in the field of resource exploration, natural calamities, health and environmental management.
5.	**Identify, Appreciate and Evaluate** the engineering geological problems coming under Civil Engineering practices and **examine** the **solutions** for them

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE219.1	**2**	2				**2**							2	2	
21CVE219.2	**2**	2				**2**	2						2	2	
21CVE219.3	**2**	2				**2**	2						2	2	
21CVE219.4	**2**	2				**2**	2						2	2	
21CVE219.5	**2**	2				**2**	2						2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Legget, Robert F & Hatheway, Allen W., (1988) ***Geology and Engineering*** 3rd ed., Mc. Graw Hill Book company, Singapore
2.	Valdiya, K.S. (2005) ***Environmental Geology*** John Wiley & sons, New Delhi
3.	Anji Reddy, M. (2012) ***Text Book of Remote Sensing and Geographical Information Systems***, Fourth Edition, BS Publication, Hyderabad

REFERENCE BOOKS:	
1.	Krynine, Dimitri. P & Judd, William. R (1998) ***Principles of Engineering Geology andGeotechnics***, Tata McGraw Hill Publ. Co., New Delhi
2.	Keller, Edward A., (1985) ***Environmental Geology*** 4th Ed., CBS Publishers & Distributors, Delhi
3.	Johnson, Robert. B & De Graff V. Jerome (1989), ***"Principles of Engineering Geology and Geotechnics",*** Mc Graw Hill Book co.. London
E Books / MOOCs/ NPTEL	
1.	https://swayam.gov.in./nd1_noc20_ce33/preview
2.	https://nptel.ac.in/courses/105/105/105105106

INTRODUCTION TO GEOINFORMATICS

Course Code:	21CVE220	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	**Explain** the basic principles of Geoinformatics comprising Remote sensing, Photogrammetry, GPS, GNSS& GIS
2.	**Explain** the stages and techniques of photogrammetry, aerial photo interpretation, visual & digital image processing, enhancement and interpretation
3.	**Explain** and **Appraise** GIS - its components, data structures, process and operation, Map and its projections, components, preparation and overlays
4.	**Explain** the GIS functionality and **Appraise** the significance of GEOINFORMATICS (Photogrammetry, RS, GPS, GNSS & GIS) in real world applications.

UNIT-I

16 Hours

Remote sensing and its Principles: Physics of remote sensing, EM spectrum, Blackbody concept, atmospheric windows, spectral response of common earth features.

Platforms & Sensors: Ground based, Air borne and Space borne platforms, Active and Passive Sensors, Photographic sensors, scanners, radiometers, RADAR and thermal infrared, hyper spectral remote sensing, Indian satellites and sensors: capabilities, data products

Photogrammetry: Basic principles of Aerial photography and Photogrammetry, Flight procedures, Aerial Photo Interpretation and Analysis techniques.

Satellite Image Interpretation and Analysis techniques: Visual & Digital Image interpretation, Interpretation elements, False Colour Composites (FCC).

UNIT-II

15 Hours

Digital Image Processing and Analysis: Digital image formats, pre-processing and processing (DIP), image restoration/enhancement procedures, information extraction, pattern recognition concepts, post processing procedures.

Geographic Information System -concept and spatial models: Fundamentals of GIS, spatial and non-spatial data, vector and raster GIS, GIS Hardware and software, georeferencing, digitization, thematic maps, Overlay Analysis, Operation of GIS, Co-ordinate systems and map projections, Map scale, data display and cartography.

UNIT-III

09 Hours

Geoinformatics and Virtual GIS: Modern Surveying and Geoinformatics, GPS &GNSS.

GIS Functionality: Introduction, data acquisition, preliminary data processing, data storage and retrieval, spatial search and analysis, graphics and interaction, Virtual GIS and Real-world applications.

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

1.	Define and explain the principles of Remote Sensing and list various types of platforms, sensors & resolutions in RS with a special reference to Indian satellites and data products.
2.	Explain Photogrammetry, its basic principles, elements of photo interpretation, Visual & Digital Image interpretation techniques
3.	Explain different stages involved in Digital Image Processing, various image enhancement techniques, list and classify the digital image formats and the extracted information for various purposes.
4.	Explain and Appraise GIS - its components, data structures, process and operation, Map and its projections, components, preparation and Overlays.
5.	Explain the GIS functionality and appraise the significance of GEOINFORMATICS (Photogrammetry, RS, GPS, GNSS & GIS) and Virtual GIS in real world applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE220.1	2	2				2							2	2	
21CVE220.2	2	2				2	1						2	2	
21CVE220.3	2	2				2	1						2	2	
21CVE220.4	2	2				2	1						2	2	
21CVE220.5	2	2				2	1						2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anji Reddy, M. (2012) ***Text Book of Remote Sensing and Geographical Information Systems,*** Fourth Edition, BS Publication, Hyderabad
2.	Bhatta, Basudeva (2011) ***Remote Sensing and GIS***, 2nd edition, Oxford University Press, N. Delhi
3.	Lillesand, T.M., Kiefer, R.W and Chipman, J.W. (2015) ***Remote sensing and Image Interpretations,*** 7th edition, John Wiley and sons, New Delhi
REFERENCE BOOKS:	
1.	Anji Reddy, M. and Hari Shankar, Y. (2006) ***Digital Image Processing,*** BS Pub., Hyd.
2.	Bernhardsen, Tor (2002) ***Geographic Information Systems-3rd*** Ed., Wiley India, Delhi
3.	Canada Centre for Remote Sensing **(2011)** ***Fundamentals of Remote sensing-Tutorial***
4.	Chang, Kang-tsung (2008) ***Introduction to Geographic Information Systems*** 4th Ed.,
5.	Korte, George B. (2001), ***The GIS Book***, Onword Press, Thomson Learning Inc.,USA
6.	Kumar, S. (2008) ***Basics of Remote sensing and GIS***Laxmi Publications (P) Ltd., Delhi
7.	Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., (2004) ***Geographic Information Systems and Science*** John Wiley & Sons Ltd., ESRI Press
8.	Sabins, F.L. (1997) ***Remote Sensing: Principles and Interpretation***3rd edn. WH Freeman and Company, New York, 494p.
E Books / MOOCs/ NPTEL	
1.	https://www.youtube.com/user/edusat2004
2.	https://eclass.iirs.gov.in/login

GEOINFORMATICS IN ENVIRONMENTAL ENGINEERING

Course Code:	21CVE221	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	**Explain** the fundamentals of **geoinformatics**
2.	**Explain** platforms, visual & digital image processing, enhancement and interpretation.
3.	**Explain** and **Appraise** GIS - its components, data structures, process and operation, Map and its projections, components, and its applications.
4.	**Explain** and **Remote sensing**, data sets, process and operation, and its applications.
5.	**Explain** the RS & GIS applications in environmental engineering

UNIT-I

16 Hours

Fundamentals of Remote Sensing: Definition, Physics of remote Sensing, EM Radiation and its interactions with atmosphere, Spectral reflectance of earth features, Resolution: Spatial, Spectral, Temporal and Radiometric.

Platforms, Sensors and Image Processing: Platforms, Active and Passive sensors, various satellites in orbit and their sensors, Data products, Image Processing- Visual and digital image, Interpretation, Ground truth verification, Image analysis, Image enhancement, Rectification, Classification: types, accuracy assessment.

UNIT-II

15 Hours

Introduction to GIS: GIS Components- Hardware, Software, Dataware, User. Data input, manipulation and outputs, data analysis, overlay analysis, buffer analysis, interpolation and extrapolation.

Application of Remote Sensing and GIS : Applications of remotely sensed data for identifying solid waste disposal, forest fire mapping, EIA studies , Optimal routing of solid waste using GIS –Case study, Environmental siting of industries.

UNIT-III

09 Hours

Re-modeling of water distribution system using GIS.
Environmental degradation assessment using geoinformatics.

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

1.	**Explain** the principles of remote sensing, and **list** types of platforms, sensors and resolutions in RS with a special reference to Indian satellite data products.
2.	**Explain** platforms and sensors and **discuss** digital image processing and enhancement techniques.
3.	**Explain** GIS components, data structures, process, operation, output and **discuss** their applications.
4.	**Evaluate** the applications of Geoinformatics in environmental engineering.
5.	**Remodel** the case studies related to water distribution system and **assess** the environmental degradation using Geoinformatics.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE221.1	2	2											2	2	
21CVE221.2	2	2					1						2	2	
21CVE221.3	2	2					1						2	2	
21CVE221.4	2	2					1						2	2	
21CVE221.5	2	2					1						2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anji Reddy, M. (2012) **Text Book of Remote Sensing and Geographical Information Systems**, Fourth Edition, BS Publication, Hyderabad
2.	Bhatta, Basudeva (2011) **Remote Sensing and GIS**, 2nd edition, Oxford University Press, New Delhi
3.	Lillesand, T.M., Kiefer, R.W and Chipman, J.W. (2015) **Remote sensing and Image Interpretations**, 7th edition, John Wiley and sons, New Delhi

REFERENCE BOOKS:

1.	Anji Reddy, M. and Hari Shankar, Y. (2006) ***Digital Image Processing***, BS Pub., Hyd.

2.	Bernhardsen, Tor (2002) ***Geographic Information Systems-3rd*** Ed., Wiley India, Delhi
3.	Canada Centre for Remote Sensing **(2011)** ***Fundamentals of Remote sensing-Tutorial***
4.	Chang, Kang-tsung (2008) ***Introduction to Geographic Information Systems*** 4th Ed.,
5.	Korte, George B. (2001), ***The GIS Book***, Onword Press, Thomson Learning Inc.,USA
6.	Kumar, S. (2008) ***Basics of Remote sensing and GIS***Laxmi Publications (P) Ltd., Delhi
7.	Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., (2004) ***Geographic Information Systems and Science*** John Wiley & Sons Ltd., ESRI Press
8.	***Geographic Information Systems and Science*** John Wiley & Sons Ltd., ESRI Press Sabins, F.L. (1997) ***Remote Sensing: Principles and Interpretation***3rd edn. WH Freeman and Company, New York, 494p.
E Books / MOOCs/ NPTEL	
1.	https://www.youtube.com/user/edusat2004
2.	https://eclass.iirs.gov.in/login

GROUNDWATER RECHARGE AND CONSERVATION

Course Code:	21CVE222	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	**Develop** an understanding of the basics of groundwater geology theconcepts of rainwater harvesting, water conservation and groundwate recharging with their significance and help them to **Identify** and **explain** the proper water management techniques
2.	**List, categorize** and **explain** aquifer parameters, types of wells, well inventories, **Inspect** the significance of water quality and geology in groundwater recharging.
3.	**List, appraise** and **explain** various traditional and artificial water harvesting & groundwater recharging techniques**, examine** site specific selection procedures, their benefits and problems,
4.	**Examine** different water conservation & water quality management techniques, **assess** their suitability and cost effectiveness**.**
5.	**Identify, appraise** and **explain** the application of Geoinformatics in water harvesting, conservation, artificial recharging and management of water resources

UNIT-I

15 Hours

INTRODUCTION: Water for life, rainwater harvesting and groundwater recharge: concepts, basics of groundwater geology and water conservation techniques, importance.

WELLS AND WELL INVENTORIES: Definition, types, aquifer parameters, well inventories, ground water quality, groundwater pollution, significance of geology in recharging.

UNIT-II

17 Hours

GROUNDWATER RECHARGING: Objectives, recharge, water balance, traditional, artificial, induced methods, hydro fracturing, roof top harvesting, site selection for groundwater recharging, quality of recharging water, coastal aquifers and recharging, benefits and problems.

WATER CONSERVATION AND MANAGEMENT: Water conservation for commercial and industrial facilities, water quality management, management of freshwater and wastewater, recycling and reuse of water, water conservation, need of ensuring quality and cost-effectiveness of water harvesting**.**

UNIT-III

	08 Hours

RS & GIS application in groundwater conservation, harvesting, artificial recharging and management of water resources.

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

1.	**Explain** the basics of groundwater geology, concepts of rainwater harvesting, water conservation and groundwater recharging with their significance
2.	**List, categorize** and **explain** aquifer parameters, types of wells, well inventories, **Inspect** the significance of water quality and geology in groundwater recharging.
3.	**List, appraise and explain** various traditional and artificial water harvesting and groundwater recharging techniques, site specific selection procedures, their benefits and problems,
4.	**Examine** different water conservation & water quality management techniques, **assess** their suitability and cost effectiveness
5.	**Identify, appraise** and **explain** the application of Geoinformatics in water harvesting, conservation, artificial recharging and management of water resources

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE222.1	2	2				2	2						2		
21CVE222.2	2	2				2	2						2		
21CVE222.3	2	2				2	2						2		
21CVE222.4	2	2				2	2						2		
21CVE222.5	2	2				2	2						2	2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Patel, A.S., and Shah, D.L., (2008), "***Water Management***" New Age International Publishers, New Delhi
2.	Karanth, K.R., (1987), "***Groundwater Assessment Development and Management***", Tata McGraw Hill Publishing co. Ltd., New Delhi

REFERENCE BOOKS:

1.	Todd, D.K., (1980), "***Groundwater Hydrology***", 2nd ed. John Wiley and Sons, New York

2.	**Karnataka State Pollution Control Board, (2007). "***Proceedings of International Workshop of Integrated Water Resources management***t"**
3.	Sharma, P.B.S. (2008) ***Groundwater Development and Management***
4.	Mohan, Seneviratne (2008). "***A practical Approach to water conservation for commercial and Industrial facilities",*** Elsevier Publications.
5.	Lilles and Thomas N., and Kiefer, R.W: (2003). ***"Remote sensing and image interpretations",*** 6th edition, John Wiley and Sons, New Delhi
6.	Bhatta, Basudeva (2011) **Remote Sensing and GIS**, 2nd edition, Oxford University Press, New Delhi
E Books / MOOCs/ NPTEL	
1.	https://www.youtube.com/user/edusat2004
2.	https://eclass.iirs.gov.in/login

Software Advances in Pavement Design

Course Code:	**21CVE223**	**Course Type**	**PCC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the flexible pavement design technique using IRC: 37-2018 recommendations.
2.	Understand the fundamentals of flexible pavement analysis using KENLAYER application of KENPAVE software.
3.	Comprehend the rigid pavement design technique using IRC: 58-2015 recommendations.
4.	Understand the fundamentals of rigid pavement analysis using KENSLAB application of KENPAVE software.
5.	Carry-out the design of bituminous overlay design using IRC: 81 and IRC:115 guidelines.

UNIT-I

15 Hours

Flexible Pavement Design using IRC 37-2018 guidelines - Introduction, Fundamental concepts in flexible pavement design as per IRC 37-2018, Steps in design of pavement, Pavement design examples for (i) Pavement section with bituminous layer(s), granular base and GSB; with bituminous layer(s), granular crack relief layer, CTB, and CTSB; (ii) Pavement Section with bituminous layer(s), SAMI crack relief layer, CTB, and CTSB showing; (iii) Pavement Section with bituminous layer(s), emulsion/foam bitumen stabilised RAP/virgin aggregate layer and CTSB; (iv) Pavement Section with bituminous layer(s), granular crack relief layer, CTB, and GSB; bituminous layer(s), granular base (WMM) and CTSB. Perpetual Pavement designs. Introduction to the use of **IIT Pave software** and design examples.

Application of KENPAVE in Flexible Pavement Design – Introduction to KENLAYER package of KENPAVE software, basic concepts, Analysis of pavement using KENLAYER package, design steps and problems.

UNIT-II

15 Hours

Rigid Pavement Design using IRC 58-2015 guidelines – Introduction, Fundamental concepts in rigid pavement design as per IRC 58-2015, Salient Features, Typical cross sections, Damage analysis, Steps in design of pavement, Design of various Components of rigid pavements as per IRC, Illustrative examples for rigid pavement design: (i) Concrete Pavement with tied concrete shoulders, (ii) Concrete Pavement with no concrete shoulders, (iii) Concrete Pavement with widened outer lanes, (iii) Concrete Pavement bonded to DLC layer. Introduction to the use of **IRC-58 2015 excel sheet** and design examples.

UNIT-III

10 Hours

Overlay Design and applications

Bituminous overlay design using IRC 81 - 1997: Introduction to BBD studies, Steps in BBD overlay design, development of excel sheets and solving the problems on overlay design.

Bituminous overlay design using IRC 115-2014: Introduction to FWD test, corrections and back calculations. Steps in FWD overlay design, Use of KGP BACK package and IIT-PAVE package for overlay design using FWD datasets. Example problems. Comparison of BBD and FWD method of overlay design.

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

1.	**Design** the structure of flexible pavement using IRC: 37-2018 recommendations
2.	**Analyze** the flexible pavement using KENLAYER application of KENPAVE software.
3.	**Design** the structure and components of rigid pavement using IRC: 58-2015 recommendations.
4.	**Analyze** the rigid pavement using KENSLAB application of KENPAVE software.
5.	**Design** flexible pavement overlay using IRC: 81 and IRC: 115 guidelines.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE223.1	3	3			1				2	2		1	2	2	1
21CVE223.2	3	3			1				2	2		1	2	2	1
21CVE223.3	3	3			1				2	2		1	2	2	1
21CVE223.4	3	3			1				2	2		1	2	2	1
21CVE223.5	3	3			1				2	2		1	2	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Yang H. Huang, "Pavement Analysis and Design", Pearson Prentice Hall, 2004
2.	Khanna. S. K, Justo. C.E.G, Veeraragavan. A, "Highway Engineering", Revised 10th edition, Nem Chand and Bros, 2014.

REFERENCE BOOKS:

1.	**IRC: 37-2018**: Guidelines for the Design of Flexible Pavements, (4th revision), Indian Roads Congress, New Delhi.
2.	**IRC: 58-2015**: Guidelines for the design of Plane Jointed Rigid Pavements for Highways, (3rd revision), Indian Roads Congress, New Delhi.
3.	**IRC: 81-1997**: Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique, (1st revision), Indian Roads Congress, New Delhi.
4.	**IRC: 115-2014**, Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique, Indian Roads Congress, New Delhi.

E Books / MOOCs/ NPTEL

1.	
2.	
3.	

Application of RS&GIS for Water resources management

Course Code:	**21CVE224**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	
2.	
3.	
4.	
5.	

UNIT-I

16 Hours

Remote Sensing – Introduction, what is Remote Sensing? Remote vs. *In Situ* Sensing, Passive and Active Remote Sensing, Sensor Types, Platforms, , Remote Sensing, Electromagnetic Spectrum (EMS), Electromagnetic Wave, EMR Energy, Energy Interactions in the Atmosphere, EM/Atmospheric Interactions: Scattering, Absorption, Atmospheric Windows, Spectral Characteristics, Sensor Selection, Spectral Reflectance Curves, specular versus diffuse reflection, Typical Spectral Reflectance curves for Vegetation, Soil and Water, Healthy Vs Stressed Vegetation, Atmospheric Influences on Spectral Response Patterns , Spatial and Temporal Effects, Advantages of Remote Sensing, Remote Sensing Images, Natural Colour Photography, False Colour composite, Remote Sensing Applications.

Aerial photography and Photogrammetry

Origin, Types of aerial photograph, Photogrammetry, Parallax, Filters, Orthophotography, Characteristics and its uses, Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution, Hyperspectral Remote Sensing, Signal-to-Noise Ratio (SNR), Storage Formats, Digital Images, Elements of digital image processing system, Comparison of Scanner Systems, Scale of an Image, Satellites & Orbits, examples Hyperspectral Imaging and its importance, DIP, Geometric Corrections, Radiometric Correction, Image Enhancement steps, Effects of Filtering, Information Extraction, Land cover analysis - Vegetation Indices, Image Classification, Objective of Image Classification, Supervised and Unsupervised Image Classification

UNIT-II

	15 Hours

GIS -What is a GIS? Spatial and non-spatial data, GIS Process, Raster, Vector Formats, Cartographic instruments, Basic properties of geographic features, Database Implementation, Role of DBMS,

MAPS –Introduction, Features, scale, classification, types, numbering of maps, Map projections, types, coordinate system.

GPS Introduction, How GPS Works? Principle, Segments, Trilateration, Navigation System Worldwide, Types of GPS Survey, Errors in GPS, Differential GPS, IRNSS, Applications of GPS.

Hands on sessions

1. Introduction to QGIS, Importing vector and raster data, attribute table, metadata, feature selection, data export.
2. QGIS Plugins, downloading and installing, importance, open street map
3. Georeferencing an Image downloading map, importing, plugin, transformation setting
4. Creating Vector Features-point, lines and polygon, feature editing, adding attributes.
5. Vector Functions and querying, dissolve, join tables, split and merge vector, extraction, overlay, buffer and spatial query.
6. Data Acquisition and raster functions, DEM, terrain analysis –slope, aspect, hill shade and contour, raster calculator, interpolation, clipping
7. Map composition styling and labelling in QGIS, map elements, Map composition.
8. Bhuvan geoportal and Google earth, utilities, data preparation, importing data to QGIS
9. Introduction to Web GIS and Geoserver –Data sharing, geospatial web services, advantages, publishing vector file. creating workspace, editing new data source.

Geoserver – Raster and SLD Integration publishing raster file creating SLD file, applying styles

UNIT-III

	09 Hours

1. Project work
2. Project work
3. Project work
4. Project work
5. Project work presentation and submission

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

1.	Mather P.M., "Computer processing of remotely sensed images: an introduction", Wiley. – 1988.
2.	Jensen J.R., "Introductory digital image processing: A remote sensing perspective", 2nd Edition, Prentice Hall – 1996.
3.	Richards J A., X. Jia, "Remote sensing digital image analysis: an introduction", 3rd Edition, Springer - 1999.
4.	Peter A. Burrough & Rachel A. McDonnel "Principles of geographic information systems"- (1998), Oxford University press, Great Britain.
5.	Chang, "Geographical Information Systems", McGraw Hill Book Co., 2007.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
21CVE224.1															
21CVE224.2															
21CVE224.3															
21CVE224.4															
21CVE224.5															

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Lillesand T.M., and R.W. Kiefer, "Remote sensing and Image interpretation", 4th edition, John Wiley & Sons – 2012.
2.	Gonzal, R.C., Wood, R.E., Digital Image processing, Pearson International Publication, 2010.
3.	Manoj K. Arora, R.C. Badjatia, "Geomatics Engineering", Nemichand & Bros. Roorkee – 2011.

4.	Burrough, P.A., Principles of Geographical Information System for Land Resource Assessment, Oxford University Press, 2010.
REFERENCE BOOKS:	
1.	Mather P.M., "Computer processing of remotely sensed images: an introduction", Wiley. – 1988.
2.	Jensen J.R., "Introductory digital image processing: A remote sensing perspective", 2nd Edition, Prentice Hall – 1996.
3.	Richards J A., X. Jia, "Remote sensing digital image analysis: an introduction", 3rd Edition, Springer - 1999.
4.	Peter A. Burrough & Rachel A. McDonnel "Principles of geographic information systems"- (1998), Oxford University press, Great Britain.
5.	Chang, "Geographical Information Systems", McGraw Hill Book Co., 2007.
E Books / MOOCs/ NPTEL	
1.	
2.	
3.	

PROJECT PLANNING USING SOFTWARES

Course Code:	**21CVE225**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To study the types of projects, organization structure and project life cycles
2.	To study the creation of project file and input data using M S Project.
3.	To study the techniques of network analysis, prepare WBS and estimate resources, duration.
4.	To schedule a project, assign resources and track status of project.
5.	To prepare the progress report and perform earned value analysis of the project.

UNIT-I

15 Hours

Project definition, Time bound project, Cost bound project, Performance (quality) bound project, Safety bound project. Project sequence, Organization structure, Bar chart, Mile stone chart, Project life cycles.

Working in MS Project: Creating a Simple Project, Setting Up a Project File, Identifying the activities.

UNIT-II

16 Hours

Network Analysis - Activity and event, Floats; Precedence diagrams, Activity definition, Work break down structures (WBS), Estimation – Resources, duration. Project management plan, Progress reporting, Cost control, Earned value analysis.

Working in MS Project: Building a Schedule, building a Team for Project, Assigning Resources to Tasks, Setting Up a Project Budget, Tracking Status, Managing Change.

Evaluating and Correcting Project Performance, Reporting on Projects, closing a Project, Working on More Than One Project, Exchanging Data Between Programs, Linking and Embedding.

UNIT-III

09 Hours

Working in Primavera: Overview of Primavera, Creating Simple Project, Scheduling, Assigning Resources.

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

1.	**Explain** the types of projects, organization structure and project life cycles. (L2
2.	**Create** a project file and input the data using M S Project. (L3)
3.	**Plan** a project using the techniques of network analysis; **Organise** WBS and **Estimate** resources, duration. (L5)
4.	**Develop** the schedule of a project, assign resources and track status of project. (L3)
5.	**Compile** the progress report and **analyse** earned value of the project. (L6)

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	2	3
21CVE225.1	2				3	2			2	2	2	2	2	2	
21CVE225.2	2	1			3	2			2	2	2	2	2	2	
21CVE225.3	2	2	2		3	2			2	2	2	2	2	2	2
21CVE225.4	2		2		3	2			2	2	2	2	2	2	
21CVE225.5	2	2	2		3	2			2	2	2	2	2	2	2

1: Low 2: Medium 3: High

Scheme of Evaluation: CIE

A project report should include Schedule, WBS, Resource Estimation, Duration Estimation and budget for the following projects

a. Residential project

b. Multi-storeyed project

SEE

- Scheduling a Project in software : 10 Marks
- Preparation of WBS : 10 Marks
- Assigning of resources and cost : 10 Marks
- Reporting on project : 10 Marks
- Viva voce : 10 Marks
- Total : 50 Marks

TEXTBOOKS:

1.	Project Planning and Control Fourth Edition (2003) Eur Ing Albert Lester, CEng, FICE, FIMechE, FIStructE, FAPM, Elsevier Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP

2.	Practice standard for work breakdown structures, Project Management Institute, Newtown square, Pennsylvania USA, 2001.
3.	Thomas E Uher, Programming and scheduling techniques, UNSW press book, 2003.
REFERENCE BOOKS:	
1.	Paul Eastwood Harris, Planning and Control using Microsoft® PROJECT 2013 and 2016, East wood Harris Pty Ltd, 2016.
2.	Bonnie Biafore, Microsoft Project 2013 The missing manual, O'Reilly Media, Inc., first edition 2013.
E Books / MOOCs/ NPTEL	
1.	
2.	
3.	

JAVA PROGRAMMING

Course Code:	21CVE226	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	
2.	
3.	
4.	
5.	

UNIT-I

16 Hours

Introducing Classes – Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, this keyword, Method overloading, Using objects as parameters, Argument passing, Returning objects, Access control, static, final, Using command line arguments, variable length arguments.

Inheritance – Inheritance Basics, Using super, creates a Multilevel Hierarchy, When constructors are called? Method Overriding, Using abstract classes, Using final with Inheritance.

Packages and Interfaces – Packages, Access protection, Importing Packages, Interfaces.

Exception Handling – Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, multiple catch Clauses, Nested try statements, throw, throws, finally.

UNIT-II

15 Hours

Multithreaded Programming – The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Inter-thread Communication.

Event Handling -Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model.

Working with Windows, Graphics and Text - Overview, AWT Classes, Window Fundamentals, Working with Frame Windows, Creating a Frame Window in an Applet, Creating a Windowed Program, Displaying Information within a Window, Working with Graphics, Working with color, Setting the Paint Mode, Working with Fonts, Managing Text Output Using Font Metrics.

UNIT-III

09 Hours

Introducing Swings – component and container, Event handling, Painting. Exploring Swings, Swings UI components.

Input/Output – I/O Basics, Reading Console Input, Writing Console Output, The Print Writer Class.

File Handling - Serial Access Files, File Methods, Redirection, Command Line Parameters, Random Access Files.

Java Database Connectivity (JDBC) - The Vendor Variation Problem, SQL and Versions of JDBC, Creating an ODBC Data Source, Simple Database Access, Modifying the Database Contents, Transactions, Meta Data

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

1.	
2.	
3.	
4.	
5.	

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2	3
21CVE226.1															
21CVE226.2															
21CVE226.3															
21CVE226.4															
21CVE226.5															

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	The Complete Reference Java by Herbert Schildt, Seventh Edition, 2007, Tata McGraw-Hill.
2.	An Introduction to Network Programming with Java by Jan Graba, 2007, Springer Publications.
3.	Programming with World Wide Web by Robert W.Sebesta, Fourth Edition, Pearson Education.

REFERENCE BOOKS:

1.	The Complete Reference J2EE by Jim Keogh, 2002, Tata McGraw-Hill.
2.	Java – How to Program? by H. M. Deitel, 2004, Prentice Hall.

OPEN ELECTIVE - (VII Semester) – 2024

Sl. No	Code	Name	Intake
1.	**21HU8X03**	**Intellectual property rights** *(for all except Robotics & except for those who have taken the subject in the VI semester)*	65
2.	**21CV8X07**	**Environment Impact Assessment** *(for all except Civil & except for those who have taken the subject in the VI semester)*	60
3.	**21ME8X08**	**Industrial Pollution Control** *(for all except Mechanical & except for those who have taken the subject in the VI semester)*	60
4.	**21EE8X10**	**Non-Conventional Energy Systems** *(for all except EE, Mech.)*	60
5.	**21CS8X15**	**Essentials of Information Technology** (for all except CS, CCE, AIML & IS)	60
6.	**21EC8X18**	**Consumer Electronics** (for all except EC)	60
7.	**21ME8X28**	**Operations Management and Entrepreneurship** *(for all exceot Robotics, Mechanical & except for those who have taken the subject in the VI semester)*	60
8.	**21ME8X33**	**Human Resource Management** (for all except Mechanical)	60
9.	**21HU8X37**	**Linguistics and Language Technology** (for all)	60
10.	**21BT8X40**	**Bio Fuel Engineering** (for all except BT & *except for those who have taken the subject in the VI semester)*	60
11.	**21ME8X65**	**Automotive Engineering** (For all except Mechanical)	60
12.	**21CV8X67**	**Disaster Management** (For all except Civil)	60
13.	**21HU8X68**	**Introduction to Yoga** *(for all except for those who have taken the subject in the VI semester)* ***(The classes will be conducted from 6.30 a.m. to 7.30 a.m.)***	50
14.	**21HU8X70**	**Overview of Indian Culture and Arts** (for all *except for those who have taken the subject in the VI semester)*	50
15.	**21HU8X71**	**Principles of Physical Education** (The classes will be conducted from 5.30 p.m. to 6.30 p.m.. Those who are willing to come at 5.30 p.m. should only register) & for all *except for those who have taken the subject in the VI semester*	50
16.	**21HU8X72**	**Introduction to Japanese language** (for all) (Students with no backlogs, CGPA should be above 7.0 & who have intention to work for Japanese companies in India or Japan) – **Registration fee for this subject is Rs.1500/- & classes will be held on Saturday)**	60
17.	**21ME8X75**	**Sustainable Development Goals** (for all *except for those who have taken the subject in the VI semester)*	60
18.	**21CS8X80**	**Internet of Things** (for all except EC, CS, CCE, AIML, IS & Robotics)	30
19.	**21IS8X83**	**Software Engineering Practices** (for all except CS, AIML, CCE & IS)	60
20.	**21IS8X84**	**Introduction to Cyber Security** (for all except CS, CCE & IS)	60
21.	**21EC8X85**	**Space Technology & Applications** (for all except E&C)	60
22.	**21ME8X88**	**Marketing Management** (for all except Mechanical & *those who have taken the subject in the VI semester)*	60
23.	**21CC8X94**	**Next Generation Wireless Networks** (for all except CCE & *except for those who have taken the subject in the VI semester)*	60
24.	**21AI8X95**	**Introduction to Artificial Intelligence & Machine Learning** (for all except AIML, CCE, CS, IS & Robotics & *except for those who have taken the subject in the VI semester)*	60
25.	**21RI8X91**	**Micro Aerial Vehicle** (for all except Robotics)	40
26.	**21CV8X96**	**Sustainability Engineering** (for all)	60

INTELLECTUAL PROPERTY RIGHTS

Course Code	**21HU8X03**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	Understand the creativity component in intellectual property, different types of legal protection of intellectual properties and other basic concepts of Intellectual property.
2.	Analyze different types of protection for inventions, different types of agreements and treaties for Intellectual properties with an ability to examine patent types, specifications and patent search and database for 'prior art'.
3.	Understand the basic procedure of drafting claims, apply for patents, other legal forms of intellectual property rights and also to examine the protocol involved in protection of inventions like patents.

UNIT - I

Introduction to Intellectual Property Invention and Creativity - Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; History and evaluation of IPR – like Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.	8
Agreements and Treaties History - General Agreement on Trade and Tariff (GATT). Indian Position vis-a-vis WTO and Strategies; TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities – Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2017	8

UNIT - II

Basics of Patents and Concept of Prior Art Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in the context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, WIPO, IPO, etc.)	8

Patent filing procedures National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies	8

UNIT - III

Case Studies: Patents: Biological Cases - i) Basmati rice ii) Turmeric iii) Neem; Non-biological cases – (i) TVS V/S Hero, (ii) Samsung V/S Nokia – Copyright and related rights – Trade Marks – Trade secrets - Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition; Technology transfer and license agreements (US anti-HIV drug license to Africa)	7

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

1.	Have a General understanding of the Intellectual Property Rights.
2.	Have awareness of different forms of intellectual property rights, national and international IPR related legislations.
3.	Have a general understanding about the provisions, privileges and limitations of intellectual property right holders with an understanding of the legal aspects (civil or criminal) of the use of intellectual property rights.
4.	Acquire Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
5.	Be aware and have a general understanding of patenting procedures and licensing.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1		3	3	2		3			2	2		3		
CO2	2	2	3			3		3	1	1	2	2		
CO3	2			2		3			2	2	2	3		
CO4			1	1		3			1	2		3		
CO5	3	2	1			3			3	1		2		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2.	Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
3.	Subbaram N.R. "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4.	Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
5.	Intellectual Property Today: Volume 8, No. 5, May 2001,
6.	WTO and International Trade by M B Rao. Vikas Publishing House Pvt. Ltd.
7.	Correa, Carlos M. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options, Zed Books, New York 2000
8.	Wadehra, B. L. Law relating to patents, trademarks, copyright designs & geographical indications 2 ed. Universal Law Publishing 2000
9.	Sinha, Prabhas Chandra Encyclopedia of Intellectual Property Rights, 3 Vols. Eastern Book Corporation, 2006.
10.	"Practical Approach to Intellectual Property Rights"; Rachna Singh Puri and Arvind Vishwanathan, I. K. International Publishing House Pvt. Ltd.

E-RESOURCES:

1.	http://www.w3.org/IPR/
2.	http://www.wipo.int/portal/index.html.en
3.	http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4.	www.patentoffice.nic.in
5.	www.iprlawindia.org/

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ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	**21CV8X07**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Identify the need to assess and evaluate the impact of projects on environment.
2. Explain major principles of environmental impact assessment.
3. Understand the different steps within environmental impact assessment.
4. Appreciate the importance of EIA for sustainable development and a healthy environment.

UNIT – I

Evolution of EIA: Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and Comprehensive EIA, General Framework for Environmental Impact Assessment, EIA Specialized areas like environmental health impact assessment, Environmental risk analysis.

16 Hours

UNIT - II

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment, Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation.

10 Hours

UNIT – III

Fault free analysis, Consequence Analysis, Introduction to Environmental Management Systems, Environmental management plan-Post project monitoring Environmental Audit: Cost Benefit Analysis, Life cycle Assessment. Case studies on project, regional and sectoral EIA.

13 Hours

Course Outcomes:

At the end of the course the student will be able to

1. Understand phenomena of impacts and know the impact quantification of various projects in the environment.
2. Liaise with and list the importance of stakeholders in the EIA process.
3. Know the role of public in EIA studies.
4. Overview and assess risks posing threats to the environment.
5. Assess different case studies/examples of EIA in practice.

Course Articulation Matrix :

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

Note:- 1:Low 2:Medium 3: High

TEXTBOOKS:

1. Noble, L. 2010. Introduction to environmental impact assessment. A Guide to Principles and Practice. 2nd edition. Oxford University Press, Don Mills, Ontario.
2. Larry W. Canter, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996

ADDITIONAL REFERENCE MATERIALS

1. Morris and Therivel, 2009. Methods of Environmental Impact Assessment, 3rd edition. New York, NY: Routledge.
2. Hanna, K.S. 2009. Environmental impact assessment. Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario.

NPTEL SOURCES

http://nptel.ac.in/courses/120108004/
http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

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INDUSTRIAL POLLUTION CONTROL			
Course Code	**21ME8X08**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives: This Course will enable students to,	
1	Know the Consequences of pollution, relationship between man and environment over the last few decades, necessity of modern awareness on pollution and how carbon audit can help in developing a carbon strategy.
2	Identify the Importance of Meteorology in pollution control and global warming, various types of plume dispersions and its effect; analyze various levels of plume height for different pollutants.
3	Distinguish Particulates and fly ash separation techniques such as cyclone separator, electrostatic precipitator efficiency calculations etc.
4	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants.
5	Summarize the Effects of water, soil, plastics and odor pollution their control techniques, Different Pollution Control Acts, Legal aspects of pollution control and how these acts can help in bringing down the pollution rate.

UNIT - I

Introduction to Pollution

Man and the environment, types of pollution and its consequences, Changing environmental management concept, sustainable industrial growth, carbon audit, Ill effects of various pollutants, permissible concentration levels & AQI.

Meteorology

Meteorology, Wind rose, Lapse rate, plume dispersion studies & Numerical problems

15 Hours

UNIT – II
Separation techniques Different types of Particulates, Need for Separation techniques, Sources of Particulates Matter Fly Ash Electrostatic precipitator (Problems) Theory of settling processes (Design Problems), Bag House fabric filter Cyclone separator Spray Tower Scrubbers & Venturi Scrubber **Smoke and gaseous pollutants** Smoke- White, blue and black smoke, Sources of smoke, T,T,T-O Principle of smoke Measurement of stack smoke intensity using Ringlemann Chart and Smokescope & Bosch Smoke meter, Domestic and Industrial Incinerators-Design factors, Pollutant gaseous So2, Co, UBHC, Nox their ill effects and & control methods.. **15 Hours**
UNIT – III
Water, soil, noise, and odor pollution, their control methods, problems associated with nuclear reactors, Legal aspects of pollution control in India, brief details of Euro and BS standards. **9 Hours**

Course Outcomes:

At the end of the course the student will be able to

CO 1	Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.
CO 2	Outline the instruments for Meteorological measurements, distinguish types of plume dispersions and its effect; analyze the concentration of various gaseous pollutants from T-Z diagrams.
CO 3	Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency.
CO 4	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants
CO 5	Identify Effects of water, soil, plastics and odor pollution on environmental Pollution and explain the Legal aspects of pollution control.

TEXTBOOKS:

1. "Environmental Pollution Control Engineering, *Wiley Eastern Ltd.*,
2. "Introduction to Environmental Engineering & Science", Gilbert M Masters, PHI,1995
3. "Environmental Pollution Control Engineering, *C. S RAO New Age Int.*

REFERENCE BOOKS:

1. *"Air Pollution"*, Henry C. Perkins, Mc-Graw Hill, 1974.
2. *"Air Pollution control"*, W. L. Faith, *John Wiley*

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/105106119/36

Course Articulation Matrix

Course Code / Name : 21ME8X08/ Industrial Pollution Control														
Course Outcomes (CO)	**Program Outcomes (PO)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-21ME8X08.1	2								1	1		1		
C-21ME8X08.2	2								1	1		1		
C-21ME8X08.3	2								1	1		1		
C-21ME8X08.4	2								1	1		1		
C-21ME8X08.5	2								1	1		1		

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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NON-CONVENTIONAL ENERGY SYSTEMS			
Course Code	**21EE8X10**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Eligible Students: For all engineering stream except E&E and Mechanical Engineering

Prerequisite:
Students are expected to have a fundamental knowledge of Basic Electrical Engineering (18EE104)

Course Learning Objectives (CLO):

1. To illustrate the principle of extraction of energy from conventional, nonconventional sources.
2. To demonstrate the working principle and applications of solar based thermal, electrical and PV systems.
3. To justify the usage of energy storage techniques and understand the process of design and implement wind based energy conversion systems.
4. To understand the process of design and implement biomass based energy conversion systems.

UNIT – I

Energy Sources: Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources, Conventional Energy Resources- Availability and their Limitations, Non-Conventional Energy Resources- Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.

3 Hours

Solar Energy Basics: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems), Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

5 Hours

Solar Thermal Systems: Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, Concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green House.

4 Hours

Solar Electric Systems: Solar Thermal Electric Power Generation, Solar Pond and Concentrating Solar Collector(Parabolic Trough, Parabolic Dish, Central Tower Collector), Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems- stand-alone and grid connected, Applications- Street lighting, Domestic lighting and Solar Water pumping systems.

4 Hours

UNIT – II

Energy Storage: Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)

4 Hours

Wind Energy: Introduction, Wind and its Properties, History of Wind Energy Wind Energy Scenario – World and India. Basic principles of WECS, Classification, Parts of a WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS. Wind site selection consideration, Advantages and Disadvantages of WECS.

4 Hours

Biomass Energy: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production

from waste biomass, Factors affecting biogas generation, types of biogas plants- KVIC and Janata model, Biomass program in India

6 Hours

UNIT – III

Energy From Ocean: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plant, Estimation of Energy – Single basin and Double basin type TPP (no derivations, Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle), Hybrid cycle, Site-selection criteria, Biofouling, Advantages & Limitation of OTEC

5 Hours

Emerging Technologies: Fuel Cell, Small Hydro Resources, Hydrogen Energy and Wave Energy (Principle of Energy generation using block diagrams, advantages and limitations)

4 Hours

Course Outcomes:

At the end of the course student will be able to

1. Describe non-conventional energy sources and solar radiation geometry to estimate and measure solar radiation.
2. Apply the principle of solar radiation into heat to understand the operation of solar thermal and solar electric systems.
3. Describe energy storage methods and wind–energy conversion systems to understand the factors influencing power generation.
4. Review the biomass conversion technologies to design biomass-based energy systems.
5. Describe tidal, ocean thermal and fuel cell energy conversion systems to understand emerging non-conventional energy technologies.

Course Outcomes: Mapping with Program Outcomes												
Program Outcomes→ ↓ **Course Outcomes:**	1	2	3	4	5	6	7	8	9	10	11	12
21EE8X10.1	2	3				1	2	1				
21EE8X10.2	2	3				1	2	1				
21EE8X10.3	2	3				1	2	1				
21EE8X10.4	2	3				1	2	1				
21EE8X10.5	2	3				1	2	1				

1: Low 2: Medium 3: High

SEE Question Paper Pattern:

- There will be **8** questions of **20** marks each in the question paper categorized into **3 Units** as per the syllabi & contact hours. The student will have to answer **5** full questions, selecting **2** full questions each from **Unit - I**&**Unit – II** and **1** full question from **Unit – III**.

TEXTBOOK:

1. Rai G. D., "Non-Conventional Sources of Energy", 4th Edition, Khanna Publishers, New Delhi, 2007

REFERENCE BOOKS:

1. Mukherjee D. and Chakrabarti, S., "Fundamentals of Renewable Energy Systems", New Age International Publishers, 2005.
2. Khan, B. H., "Non-Conventional Energy Resources", TMH, New Delhi, 2006
3. S. P. Sukhumi, J. K. Nayak "Solar Energy: Principles Collection and Storage", 3rd edition, McGraw-Hill Education (India) , 2009

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ESSENTIALS OF INFORMATION TECHNOLOGY			
Course Code	**21CS8X15**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Outline the fundamentals of python programming.
2. Implement the object oriented concepts using python programming.
3. Describe the basic concepts of Relational Database Management System.
4. Apply the normalization to the Databases and develop databases using SQL and PL/SQL Queries.
5. Develop the data base connectivity in integration with python and perform various Database operations.

UNIT - I

PROGRAMMING FUNDAMENTALS Introduction to Programming: Why Programming, What is Computer Program, What is an Algorithm, Flowchart, Pseudo Code; Python Fundamentals: – Introduction to python, Variables and Data Types, Comments, Input Function, Operators, Coding Standards, Integrated Development Environment(IDE) ;Control Structures: Selection Control Structures, ,Looping/Iterative Control Structures; Data Structures: String , List, Dictionary and Tuple ,Set, Functions: Built-in functions, User-defined Functions, Recursion.

OBJECT ORIENTED PROGRAMMING USING PYTHON Introduction to Object Oriented Paradigm: Abstraction and Entity, Encapsulation and Data hiding, Class and Object, Unified Modelling Language (UML), Object Oriented Approach, Class Variables, Class methods and Static Methods, Documentation, Inheritance & Polymorphism: UML: is-a relationship
(Generalization), Types of Inheritance, Multiple Inheritance, Polymorphism, Benefits of OOP,
Memory Management in Python, Relationships: has-a relationship: Aggregation & Composition, uses-a relationship; File handling, Exception Handling, Raising Exceptions

15 Hours

UNIT - II

RELATIONAL DATABASE MANAGEMENT SYSTEM Data and Need for DBMS: Data – Is it important, What is Data, Do we need to store data, How to Store / Handle Data, What is DBMS and its Models, Functional Needs of DBMS, Data perspectives in DBMS; Relational Model and Keys: What is RDBMS, Data representation in RDBMS, Keys in RDBMS; Database Development Life Cycle; Data Requirements; Logical Database Design: Different Approaches in Logical Design, ER Modeling, ER Notations, Steps in ER Modeling; Physical Database Design: Converting ER Model to Relational Schema ;Normalization: Functional Dependency, First
Normal Form: 1NF, Second Normal Form: 2NF, Third Normal Form: 3NF, Normalization
Guidelines;

Implementation with SQL: What is SQL, Data types and Operators in SQL, SQL Statements: SQL - Built-in Functions; SQL - Group by and Having Clauses Joins: Inner Join, Outer Join, Self-Join, Sub Queries: Independent Sub queries, Correlated Sub queries, Index, Views,
Transactions, PL/SQL

15 Hours

UNIT - III

PYTHON DATABASE INTEGRATION Why Database Programming, Python Database
Integration – Pre-requisites and Installation, SELECT Operation: Retrieve Data from Database, Attributes of Cursor object, Bind variables, CREATE and INSERT Operation: Creating a table, Insert Operation, Inserting Multiple Records, UPDATE Operation, DELETE Operation, Exception Handling.

9 Hours

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

1. Explain the basic program constructs of Python Programming.
2. Design and apply the object oriented programming construct using Python to build the real world application.
3. Summarize the concepts related to Relational Database Management System.
4. Design and develop databases from the real world by applying the concepts of Normalization using SQL and PL/SQL.
5. Perform the various Database operations by connecting Python with Database.

Table-2: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3		1				1	1		1		3	
CO2	1	2	3		1				1	1		1		3	3
CO3	1	2	3											3	
CO4	2	3												3	3
CO5	1	2	3		1				1	1		1		3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs, 2012", Cengage Learning.
2. Magnus Lie Hetland, "Beginning Python from Novice to Professional", Second Edition.
3. Mark Summerfield, Programming in Python 3 – "A Complete Introduction to the Python Language", Second Edition.
4. Elmasri, Navathe, "Fundamentals of Database Systems", Third edition, Addison Wesley

REFERENCE BOOKS:

1. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, ISBN:9780-13274718-9, 2013.
2. Raghu Ramakrishnan and Johannes Gehrke: "Database Management Systems" (Third Edition), McGraw-Hill, 2003.

SEE SCHEME:

There will be **8** questions of **20** marks each in the question paper divided into**3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit-III**

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CONSUMER ELECTRONICS			
Course Code	**21EC8X18**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Learn and design operating principles of "real world" electronic devices
2. Study broader view of key principles of electronic device's operation and presents a block circuit diagram.
3. Learn to integrate the many different aspects of emerging technologies and able to build unique mix of skills required for careers.

UNIT – I

Sound: Properties of sound and its propagation, Transducers (Micro Phone, Loud Speakers), enclosures, mono-stereo, Amplifiers, Multiplexers, mixers, Synthesizers.
Vision: B/W TV, CTV concepts, B/W & Color Cameras, Displays.

15 Hours

UNIT – II

Recording and Playback: Optical discs; recording and playback, audio and video systems, Theatre Sound, Studios, Editing.
Communications and Broadcasting: Switching Systems, Land lines, Modulation, Carrier, Fiber optics, Radio and TV broad casting
Data Services: Data services, mobiles, terrestrial & Satellite Systems, GPS, Computers, internet Services.

15 Hours

UNIT – III

Utilities: Fax, Xerox, Calculators, Microwave ovens, Washing Machines, A/C & refrigeration, Dishwashers, ATMS, Set -Top boxes, Auto Electronics, Industrial Electronics, Robotics, Electronics in health / Medicine, nano- technologies.

9 Hours

Course Outcomes:

At the end of the course the student will be able to

1. Recall basics of sound.
2. Recall basics of television and camera.
3. Explain basic working of Recording, storage devices,
4. Explain basics of communication and broadcasting.
5. Recall basic working of commonly used electronic gadgets

TEXTBOOKS:

1. Anand, **"Consumer Electronics",** Khanna publications, 2011.
2. Bali S. P., **"Consumer Electronics",** Pearson Education, 2005.

REFERENCE BOOK:

1. Gulati R. R., **"Modern Television Engineering",** Wiley Eastern

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

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OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

Course code	**21ME8X28**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**(3:0:0)**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives: This Course will enable students to,

1	Define production/operations management, Classify Production and service system and different type of production systems, Understand the importance of CRM and ERP
2	Appreciate the importance of Quality tools and methods in operations management
3	Analyze the data draw variable process control charts and determine process capability; Understand salient issues concerning reliability
4	Understand the issues related to entrepreneurship, characteristics of an entrepreneur and different studies carried out during project appraisal.
5	Identify and differentiate the different national and state level funding agencies.

UNIT – I

Introduction to Production/ Operations Management: Concept of production, Classification of production systems, Production Management, Concept of operations, Distinction between Manufacturing Operations and Service Operations, Objectives of Operations Management (Customer Service and Resource utilization/ Competitive advantage through Quality-Delivery-Cost), Scope of Operations Management. Introduction to Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).

7 Hours

Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement, Key dimensions of Quality, Concept of cost of quality. Customers' perception of quality.

TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM.

Managing Quality: Quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, 7 QC tools,

Philosophy of statistical process control and modeling process quality: Normal distribution tables, Finding the Z score, Central limit theorem, Chance and assignable causes of variation, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, warning limits)

9 Hours

UNIT – II

Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, Simple Numerical Problems,

Process capability: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems. Concept of Six sigma.

Introduction to reliability, Mean time to failure, Mean time between failures, Bath tub curve, Reliability of series and parallel systems, Numerical problems on the above topics.

8 Hours

Entrepreneurship: Concept of Entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in Economic Development, Barriers to Entrepreneurship, Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an emerging Class.

Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Application of Operations Management concepts in Facility/ Business Location: General procedure for making locations decisions, Numerical Problems on application of Breakeven analysis and Transportation method to make location decisions.

8 Hours

UNIT – III

Small scale industries: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only)

Institutional Support: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

7 Hours

Course Outcomes (CO)

CO 1	Differentiate production and service systems. Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
CO 2	Discuss Total Quality Management tools and methods. Solve problems on fundamentals of statistics and normal distribution.
CO 3	Draw and Analyze variable process control charts and determine process capability. Calculate reliability of series and parallel systems using the information on failure rate and time.
CO 4	Discuss entrepreneurship, characteristics of an entrepreneur and barriers to entrepreneurship. Discuss the elements of a project report and feasibility studies conducted in the project appraisal.
CO 5	Identify and differentiate the national and state level funding agencies. Discuss the effect of GATT and WTO on Indian economy.

TEXTBOOKS:

1. **Production / Operations Management**, Joseph G Monks, McGraw Hill Books
2. **Production and Operations Management**, William J Stevenson, Tata McGraw Hill, 8th Edition.
3. **Statistical Quality Control**: RC Gupta, Khanna Publishers, New Delhi, 2005.
4. **Total Quality Management**: Dale H. Besterfield, Pearson Education, 2003.
5. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai – Himalaya Publishing House
6. **Entrepreneurship Development** – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (2 & 4).

REFERENCE BOOKS:

1. **Statistical Quality Control:** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher.
2. **Statistical Process Control and Quality Improvement:** Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
3. **Statistical Quality Control for Manufacturing Managers:** W S Messina, Wiley & Sons, Inc. New York, 1987
4. **Statistical Quality Control:** Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
5. **Principles of Quality Control:** Jerry Banks, Wiley & Sons, Inc. New York.
6. **Entrepreneurship Development** – S.S.Khanka – S.Chand & Co.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/110105067/
2. https://www.edx.org/course/operations-management-iimbx-om101-1x

Course Articulation Matrix

Course Code / Name:21ME8X28/ Operations Management & Entrepreneurship															
Course Outcomes (CO)	**Program Outcomes (PO)**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21ME8X28.1	3	1	0					1	1	1	1				
C-21ME8X28.2	1	2	0						1	1	3				
C-21ME8X28.3	2	2	0				1	0	1	1	3				
C-21ME8X28.4	3	1	0			1	0	1	1		2				
C-21ME8X28.5	1	1	0			1	1	1	1		3				

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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HUMAN RESOURCE MANAGEMENT			
Course Code	**21ME8X33**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1) To develop a meaningful understanding of HRM theory, functions and practices.
2) To understand concepts and skills recruitment.
3) To understand the concepts of training and development.
4) To deal with employees' grievances, safety and health types of organizations.
5) To understand the concepts of e-HRM.

UNIT - I

Human Resource Management & HRP:
Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager.HR Planning. Process HRP.
8 Hours

Recruitment: Definition, Sources and Methods of Recruitment
Selection: Definition and Process of Selection. Cost benefit analysis of selection.
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods
8 Hours

UNIT – II

Training and development: Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.
Compensation: employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits. Internal Mobility, External Mobility, Trade union Act (Amendment) 2001.
7 Hours

Employee Grievances: Employee Grievance procedure. Discipline procedure
Collective bargaining; Characteristics, Necessity, Forms
Safety & Health; Industrial accidents, Safety
Quality circle; Meaning, Structure
8 Hours

UNIT – III
IHRM. Managing IHRM. e-HR Activities, Global recruitment, selection, expatriates. Industrial conflict – Causes, Types, Prevention and Settlement. **e-HRM**; Aspects of e-HRM,e-Job design & Analysis, Ethical issues in employment **8 Hours**
Course Outcomes (CO):
At the end of the course the student will be able to:
CO 1 Describe the basic concepts of HRM & HRP.
CO 2 Elucidate the HRM functions of recruitment, selections, appraisal etc.
CO 3 Apply the training, development and compensation methods in HRD.
CO 4 Identify the employee grievances and to spell out the remedial measures.
CO 5 Infer the concepts of e-HRM and I-HRM.
TEXTBOOK:
1. Essentials of Human Resource Management & Industrial Relations-P Courseba Rao, Third Revised Edition
REFERENCE BOOKS:
1) Human Resource Management - John M. Ivancevich, 10/e, McGraw Hill.
2) Human Resource Management-Flippo
3) Human Resource Management - Lawrence S. Kleeman, Biztantra , 2012.
4) Human Resource Management – Aswathappa K HPH
MOOC/NPTEL Resources:
1) http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about
2) http://nptel.ac.in/courses/122105020/

Course Articulation Matrix

Course Code / Name : 21ME8X33 / HUMAN RESOURCE MANAGEMENT														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C- 21ME8X33.1	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.2	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.3	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.4	3	-	-	-	-	1	-	-	1	1	-	1	-	-
C-21ME8X33.5	3	-	-	-	-	1	-	-	1	1	-	1	-	-

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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LINGUISTICS & LANGUAGE TECHNOLOGY

Course Code	**21HU8X37**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	Introspect about the consciousness in one's language
2.	Learn pronunciation and how the process helps to communicate effectively.
3.	Build contextual speech and writing with the pedagogy in sentence structure.
4.	Improve skill of applying language to enunciate words.
5.	Progress on the speech aspects by understanding the acquisition of Second Language.

UNIT - I

Introduction to Linguistics Broad understanding of Linguistics, Language and characteristic features, Scientific Language, Levels of Linguistic Analysis (Phonetics, Phonology, Morphology, Syntax and Semantics); Approach to Linguistics (Traditional, Structural and Cognitive).	8
Phonology and Morphology Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis, Morphology and Morphemes, Word building process, Morphological Analysis.	8

UNIT - II

Syntax Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case	16

UNIT – III

Sociolinguistics & Psycholinguistics, Artificial Intelligence Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis.	7

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

1.	Understand the importance of language and its facets.
2.	Demonstrate knowledge of sounds and competence in process of word building.
3.	Evolve to reason the constituent parts of a sentence.
4.	Understand the techniques of how 'meaning' is applied.
5.	Analyze errors in day-to-day-conversations and how language is related to society.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	PSO↓ 2
CO1		1			1	1			1			2		
CO2			2						2	2				
CO3	2	3		3					3	2				
CO4					2				1	2				
CO5		2				2	1					1		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Akmaijan, A, R. A. Dimers and R. M. Harnish. Linguistics: An Introduction to Language and Communication. London: MIT Press, 1979.
2.	Chomsky, Noam. Language in Mind. New York: Harcourt Brace Jovanovich, 1968.
3.	Fabb, Nigel. Sentence Structure. London: Routledge, 1994.
4.	Hockett, C. A Course in Modern Linguistics. New York: Macmillan, 1955.
5.	O'Grady, W., O. M. Dobrovolsky and M. Aronoff. Contemporary Linguistics: An Introduction. New York: St. Martin's Press, 1991.
6.	Pride, J. B. and J. Holmes. Sociolinguistics. Harmondsworth: Penguin, 1972.
7.	Richards, J. C. Error Analysis: Perspectives in Second Language Acquisition. London: Longman, 1974.
8.	Salkie, R. The Chomsky Update: Linguistics and Politics. London: Unwin Hyman Ltd., 1990.
9.	Sinclair, J. M. C. H. and R. M. Coulthard. Towards an Analysis of Discourse. Oxford: OUP, 1975.
10.	Thomas, Linda. Beginning Syntax. Oxford: Blackwell, 1993.
11.	Verma, S. K. and N. Krishnaswamy. Modern Linguistics: An Introduction. New Delhi: OUP, 1989.
12.	Wekker, Herman and Liliane Haegeman. A Modern Course in English Syntax. Kent: Croom Helm, 1985.

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BIOFUEL ENGINEERING			
Course Code	**21BT8X40**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

***Prerequisites*:** Nil
***Co-requisites*:** Nil

Course Learning Objectives:

The objective of this course is

- To learn the fundamental concepts of biofuels, types of biofuels, their production technologies.
- To learn the concepts of feedstock utilization and energy conversion technologies.

UNIT – I

LIQUID BIOFUELS

Description and classification of Biofuels; Primary biomass: Plant materials-Woody biomass, Lignocellulosic and agroindustrial by-products, starchy and sugary crops. Secondary biomass: Waste residues and co-products-wood residues, animal waste, municipal solid waste. Biomass production for fuel – algal cultures, yeasts (Lipid and carbohydrate).

Production of biodiesel: Sources of Oils – edible and non edible; Esterification and Transesterification. Free fatty acids; saponification; Single step and two step biodiesel production. Catalysts for biodiesel production – homogeneous (alkali/acidic) and heterogeneous; Lipase mediated process. General procedure of biodiesel production and purification Quality Control Aspects: GC analysis of biodiesel, fuel property measurements, ASTM (D-6751) and Indian standards (IS15607).Algal Biodiesel production.

Production of Bioethanol: Bioethanol production using Sugar; Starch and Lignocellulosic feedstocks; Pretreatment of lignocellulosic feed stock

15 Hours

UNIT – II

BIOHYDROGEN AND MICROBIAL FUEL CELLS

Enzymes involved in H_2 Production; Photobiological H_2 Production: Biophotolysis and Photofermentation; H_2 Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H_2 production, Carbon sources, Detection and Quantification of H_2. Reactors for biohydrogen production.

Microbial Fuel cells: Biochemical Basis; Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Power Density; MFC Performance Methods: Substrate & Biomass Measurements, Basic Power Calculations, MFC Performance: Power Density, Single vs Two-Chamber Designs, Wastewater Treatment Effectiveness; Advances in MFC.

15 Hours

UNIT – III

RECOVERY OF BIOLOGICAL CONVERSION PRODUCTS

Biogasification of municipal solid waste: Anaerobic processing; Types of digesters, Biogas plant in India.

Thermochemical processing: Planning an incineration facility, Incineration technologies: Mass burning system; Refuse derived fuel (RDF) system; modular incineration; Fluidized bed incineration; energy recovery; Fuel production through biomass incineration, Pyrolysis and gasification, hydrothermal processing.

9 Hours

Course Outcomes:

At the end of this course, student should be able to:

1. Mark the significance of biofuels and raw materials and Identify suitable feedstock for production of biofuels.
2. Illustrate the production of liquid biofuels from various feed stocks.
3. Demonstrate production of biohydrogen using microbial sources.
4. Extend the concepts of microbial fuel cells towards development of specific application.
5. Understand and apply the concepts of biochemical processing to harvest energy from waste products/streams.

Mapping of POs &COs:

	PO											
CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1		M							L			
CO2		M							L			
CO3		M							L			
CO4		M							L			
CO5		M							L			

REFERENCE BOOKS:

1. Drapcho, C. M., Nhuan, N. P. and Walker, T. H. *Biofuels Engineering Process Technology,* Mc Graw Hill Publishers, New York, 2008.
2. Jonathan R.M, *Biofuels – Methods and Protocols (Methods in Molecular Biology Series),* Humana Press, New York, 2009.
3. Olsson L. (Ed.), *Biofuels (Advances in Biochemical Engineering/Biotechnology Series,* Springer-Verlag Publishers, Berlin, 2007.
4. Glazer, A. and Nikaido, H. *Microbial Biotechnology – Fundamentals of Applied Microbiology*, 2 Ed., Cambridge University Press, 2007.
5. Godfrey Boyle (Ed). *Renewable Energy- Power for sustainable future*, 3rd Ed. Oxford. 2012.
6. Ramachandran, T. V. *Management of municipal solid waste*. Environmental Engineering Series. Teri Press, 2016.

SEE QUESTION PAPER PATTERN:

Unit No.	I	II	III
Questions to ask (20 marks/Qn)	3	3	2
Questions to answer	2	2	1

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AUTOMOTIVE ENGINEERING			
Course Code	**21ME8X65**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives: **This Course will enable students to,**	
1	Get an idea on the different components of an engine and its types with lubrication system.
2	Understand the fuel supply system and ignition systems used in automobiles.
3	Demonstrate the working of transmission system.
4	Explain the importance of suspension system, steering geometry and drives in automobiles
5	Know the concept of braking system, tyres and emission control.
UNIT – I	

ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS:
SI & CI engines, Cylinder-arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements, crankshaft/flywheel position sensor, accelerator pedal sensors, engine coolant water temperature sensor.

8 Hours

FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Fuel mixture requirements for SI engines, types of carburetors, simple carburetor, multi point and single point fuel injection systems, CRDI, fuel transfer pumps: AC Mechanical Pump, SU Electrical Pumps, injectors, Fuel gauge sensor, Throttle position sensor, Mass air flow sensors.

5 Hours

IGNITION SYSTEMS:
Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic

Ignition advance systems, Lighting systems, Rain/Light sensors, starting device (Bendix drive)

2 Hours

UNIT – II

POWER TRAINS:

Clutches- Single plate, multiplate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, Constant mesh gear box, Synchromesh gear box, principle of automatic transmission, Vehicle Speed Sensors, calculation of gear ratios, Types of transmission systems. No numerical.

8 Hours

DRIVE TO WHEELS:

Propeller shaft, universal joints, Hotchkiss. and torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe-in & toe-out, condition for exact steering, power steering, over steer, under steer & neutral steer, Steering angle sensors, numerical problems.

5 Hours

SUSPENSION AND SPRINGS:

Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front Wheel, Air suspension system**.**

2 Hours

UNIT – III

BRAKES:

Types of brakes, mechanical, compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes.

5 Hours

TYRES

Desirable tyre properties, Types of tyres.

1 Hour

AUTOMOTIVE EMISSION:

Automotive exhaust emissions, sources and emission control method: EGR, SCR, Emission Standards, Exhaust sensors.

Electric Vehicles.

3 Hours

Course Outcomes (CO):

At the end of the course the student will be able to

CO 1	**Describe** and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems.
CO 2	**Explain** and demonstrate the fuel supply and Ignition systems for SI and CI engines.
CO 3	**Describe** and demonstrate the transmission system
CO 4	**Explain** and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry.
CO 5	**Describe** and demonstrate automotive braking system. Explain types and construction of tyres and wheels. Explain the significance of automotive emissions and its controlling methods.

TEXTBOOKS:

1. Automotive Mechanics by S. Srinivasan, Tata McGraw Hill, 2003
2. Automobile Engineering, Kirpal Singh, Vol I and II, 2013.
3. Automotive Electrical and Electronics, A. K. Babu, Khanna Publishers, 2nd edition, 2016

REFERENCE BOOKS :

1. Automobile Engineering, R. B. Gupta, Satya Prakashan, 4th Edn., 1984 .
2. Automobile Engineering, Narang, Khanna Publishers 2002
3. Automotive Mechanics, Crouse, McGraw Hill 2002
4. Automotive Mechanics, Joseph Heithner 2000
5. Automobile Mechanics by N. K. Giri, Khanna publishers 2002
6. Newton and Steeds Motor Vehicle, Butterworth, 2nd Edn. 1989.
7. Automobile Engineering by K. K. Jain and R. B_ Arshana, Tata McGraw Hill, 2002
8. Automobile Mechanics, A.K. Babu & S.C. Sharma, T.R. Banga, Khanna Book Publishing
9. A Textbook of Automobile Engineering, R.K. Rajput, Laxmi Publications

List of proposed Experiments in Automotive Laboratory: 4 Hours

1. Study of Automotive - Chassis & superstructure/body and its functions. Also involves study of cut section of wheel & tyres (bias and radial types).
2. Study of more commonly used tools and equipment in automotive shop.
3. Study of carburetors and petrol & diesel fuel injection systems
4. Demonstration and study of Front axle and steering system
5. Demonstration and study of various suspension systems
6. Power train - Dismantling and assembly of single/multi cylinder Engine.
7. Power train - Study of clutch mechanism. Demonstration and study of dry friction clutches - Single plate & multi-plate types
8. Power train - Demonstration and study of transmission system - Gear box
9. Power train - Demonstration and study of Universal joints, propeller shaft, final drives, differential, and rear axles
10. Demonstration and study of brake mechanism (hydraulic type) and study of disc and drum brakes
11. Field visit to Automotive Servicing Station - Study of electrical system, wheel alignment (measuring and adjustment of castor, camber, king-pin inclination, toe-in and toe-out), automotive emission control systems.

(The details of each experiment to be given out as handout to each student or may be uploaded in Intranet)

Course Articulation Matrix:

Course Code / Name: 21ME8X65 / Automotive Engineering														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-21ME8X65.1	3	1	-	-	-	1	-	-	3	1	-	1	3	3
C-21ME8X65.2	3	1	-	-	-	1	-	-	3	1	-	1	1	3
C-21ME8X65.3	3	1	1	-	-	1	-	-	3	1	-	1	3	3
C-21ME8X65.4	2	3	1	-	-	1	-	-	3	1	-	1	2	3
C-21ME8X65.5	3	1	1	-	-	1	1	1	3	1	-	1	2	3

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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DISASTER MANAGEMENT			
Course Code	**21CV8X67**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

1. Understand difference between Disaster, Hazard, Vulnerability, and Risk.
2. Know the Types, Trends, Causes, Consequences and Control of Disasters
2. Apprehend Disaster Management Cycle and Framework.
3. Know the Disaster Management in India
4. Appreciate Applications of Science and Technology for Disaster Management.

UNIT – I

Understanding Disasters: Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Types, Trends, Causes, Consequences and Control of Disasters: Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters

15 Hours

UNIT – II

Disaster Management Cycle and Framework: Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR,YokohamaStretegy, Hyogo Framework of Action

Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter-Governmental Agencies

15 Hours

UNIT – III

Applications of Science and Technology for Disaster Management: Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Case Studies: Study of Recent Disasters (at local, state and national level)

Preparation of Disaster Risk Management Plan of an Area or Sector,

Role of Engineers in Disaster Management

Course Outcomes:

After completion of this course the students will be able to

1. **Explain** Concepts, Types, Trends, Causes of Disasters
2. **Describe** Consequences and Control of Disasters
3. **Explain** Disaster Management Cycle and Framework:
4. **Explain** the lesson learnt from the disasters in India and **discuss** the financial mechanism, roles and responsibilities of Non-Government and Inter-Governmental Agencies for Disaster management
5. **Describe** the Applications of Science and Technology recent disasters, role of engineers for Disaster Management and **prepare** a report of Disaster Risk Management Plan.

Mapping of POs & COs:

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

Note:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

REFERENCE BOOKS:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. https://nidm.gov.in/PDF/pubs/DM%20in%20India.pdf, Disaster Management in India, MHA, 2011.
3. World Disasters Report, 2018. International Federation of Red Cross and Red Crescent, Switzerland
4. Encyclopedia of disaster management, Vol I, II and III Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
5. Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008
6. Disasters in India Studies of grim reality, AnuKapur& others, 2005, 283 pages, Rawat Publishers, Jaipur.
7. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
8. Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages
9. Disaster Management Act 2005, Publisher by Govt. of India
10. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management, https://ndma.gov.in/en/publications.html#
11. NIDM Publications https://nidm.gov.in/books.asp
12. High Power Committee Report, 2001, J.C. Pant
13. Disaster Mitigation in Asia & Pacific, Asian Development Bank
14. National Disaster Management Policy, 2009, GoI
15. Disaster Preparedness Kit, 2017, American Red Cross,http://pchs.psd202.org/documents/mopsal/1539703875.pdf.
16. Subramanian R., "Disaster Management", 2018 Vikas Publishing House Pvt Ltd.

Note: There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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INTRODUCTION TO YOGA

Course Code:	**21HU8X68**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Learning Objectives:

1.	To give a brief history of the development of Yoga
2.	Identify names of different classical texts on Yoga
3.	To illustrate how Yoga is important for healthy living
4.	To explain the Asanas and other Yogic practices
5.	To explain, how Yoga practices can be applied for overall improvement

UNIT – I

Yoga: Meaning and initiation, definitions and basis of yoga, History and development, Astanga yoga, Streams of yoga.Yogic practices for healthy living. General guidelines for Yoga practices for the beginners: Asanas, Pranayama.	**09 Hours**
Classification of Yoga and Yogic texts:Yogasutra of Patanjali, Hatha yogic practices- Asanas, Pranayama, Dharana, Mudras and bandhas.	**07 Hours**

UNIT – II

Yoga and Health: Concept of health and Diseases-Yogic concept of body – pancakosaviveka, Concept of disease according to Yoga Vasistha.	**06 Hours**
Yogic concept of healthy living- rules & regulations, yogic diet, ahara, vihara. Yogic concept of holistic health.	**04 Hours**
Applied Yoga for elementary education:Personality development- physical level,mental level,emotional level. Specific guidelines and Yoga practices f**or** - Concentration development,Memory development	**04 Hours**

UNIT - III

Yoga and physical development: Mind-body, Meditation, Yogasanas and their types. Different Yoga practices and Benefits.	**05 Hours**
Specific guidelines and Yoga practices for **–** Flexibility, Stamina, Endurance (Surya Namaskara)	**04 Hours**

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

1.	Understand a brief history of the development of Yoga
2.	Know important practices and principles of Yoga
3.	Explain how Yoga is important for healthy living
4.	Practice meditation to improvement of concentration etc.
5.	Have knowledge about specific guidelines of yoga practices

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1						1			1			1		
CO2						1			1			3		
CO3						2			1			3		
CO4						3			2			3		
CO5						2			2			3		

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	B.K.S. Iyengar, "Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority", Thorsons publisher 2016.
2.	MakarandMadhukar Gore, "Anatomy and Physiology of Yogic Practices: Understanding of the Yogic Concepts and Physiological Mechanism of the Yogic Practices", MotilalBanarsidass Publishers; 6 edition (2016).
3.	Swami SatyanandaSaraswati, "Asana, Pranayama, Mudra and Bandha: 1", Yoga Publications Trust.
REFERENCE BOOKS:	
1.	Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice by Ann Swanson
2.	Yoga for Everyone : 50 Poses For Every Type of Body by Dianne Bondy
E Books / MOOCs/ NPTEL	
1.	https://onlinecourses.swayam2.ac.in/aic19_ed29/preview
2.	https://youtu.be/FMf3bPS5wDs

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OVERVIEW OF INDIAN CULTURE AND ART

Course Code	**21HU8X70**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	To understand the relevance of Culture in Human Life, dynamism of Indian Culture and Arts through ages.
2.	To understand the local culture and its vibrancies.
3.	To develop awareness about Indian Society, Culture and Arts under Western rule.
4.	To comprehend different dimension and aspects of the Indian culture and arts.
5.	To appreciate cultural performances in India.

UNIT - I

Knowing Culture What is Culture, Different aspects of Culture, Cultural expression, Importance of Culture	7
Influence of Culture Relationship of Culture with: Language, Religion and History, Gender	7

UNIT - II

Media and Culture Role of News Papers, Indian Cinema, Music, Advertisements	7
Languages, Literature and Culture Role of Sanskrit, Vedas, Upanishads, Ramayana and Mahabharata, Puranas, other Sanskrit Literature, Buddhist and Jain Literature, Dravidian Languages and Literature, North Indian Languages and Literature, Subaltern Literature	7

UNIT - III

Arts and Culture Indian Theatre and Performing Arts, Ritual performances, and Tuluva cultural and ritual performances.	7
(Self-study Component) **Contribution of Indian History to Culture** Ancient India – Persian and Macedonian invasions and its impact on Indian Culture, Development of Culture and Arts during the Mauryan Empire (Ashoka), the Guptas, the South Indian Dynasties – the Cholas, Nalanda as a Centre of Learning. Medieval India – Life of People under Delhi Sultanate, Rise of Islam and Sufism, Political Scene of India, Bhakti Movement, Folk Arts, Rise of Modern Indian Languages. Modern India – British Ruling and its impact on Indian Culture, Social and Religious Reforms, Indian National Movement and Achievement of Independence.	4

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

1.	Examine how the culture has a very important role in human life and growth of human civilization and have a general awareness on historical perspective of growth of Indian Culture and Arts.
2.	Appreciate their own local culture from an academic perspective.
3.	Know about the impact of Western Rule in India and Indian Struggle for Freedom and also its impact on Indian Culture and Arts and able to appreciate and the role of language in connecting people, growth of culture and arts beyond the barriers of religion and ages.
4.	Take interest in learning these forms of arts, and also appreciate and preserve them for the future generations feeling proud of Indian Culture, Arts and Architecture.
5.	Appreciate art performances in India which will enable them to get exposed to an artistic sphere, which eventually help them to be creative and imaginative.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1		1				3		3	3	1		3		
CO2				2		3		2	3	3		3		
CO3						3		1				1		
CO4						3		2	1	2		3		
CO5						3		3	3	3		2		

1: Low 2: Medium 3: High

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PRINCIPLES TO PHYSICAL EDUCATION			
Course Code	**20HU8X71**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Appreciate and understand the value of physical education and its relationship to a healthy active lifestyle.
2. Work to their optimal level of physical fitness.
3. Show knowledge and understanding in a variety of physical activities and evaluate their own and others' performances.

UNIT - I

History of Physical Education - Olympic games, Modern Olympic games, Olympic Ideals & Objectives, Olympic Symbols, Olympic Flag, Olympic Emblem, Olympic Motto, Olympic Flame, Asian games
International Olympic Committee (IOC), Indian Olympic Association (IOA)
Sports awards - Eligibility, Objectives & Criteria
Yoga - Meaning and Importance
World Health organization (WHO)

10 Hours

UNIT – II

Concept of Health - Meaning of Health, Health Definition, Factors Affecting Health, Qualities of Healthy Person. Health Hazards of College Students, Physical Fitness and Exercises.
Food and Nutrition -Food & Nutrition Defined, Nutrients and their Functions - i) Proteins ii) Carbohydrates iii) Fats iv) Vitamins
Balanced Diet & Malnutrition

Health Education - Meaning of Health Education, Health Education Defined, Scope of Health Education, Importance of Health Education.
Posture - Concept of Posture, Correct Postures, Common Postural Defects
First Aid - First Aid Defined, Need and importance of First Aid, The Requisites of FirstAid, Scope of FirstAid, Qualities of a First Aider, Fundamental Principles to be followed and the Duties to be performed by the First Aider, First Aid in Different Cases.
Physical Education - Concept of Physical Education, Physical Education Defined, Importance of Physical Education, Scope of Physical Education, Aims and Objectives of Physical Education.
Teaching Aid in Physical Education
Competition - Introduction, Types of competition, Knock out, League or Round Robin Tournament.

12 Hours

UNIT – III

Training in Sports – Meaning, Principles, Warming Up & Limbering Down
Importance of Anatomy and Physiology in Physical Education, Oxygen Debt and Second wind
Leadership and Supervision – Leadership, Qualities of a good leader in Physical Education, Types of Leadership in Physical Education - 1. Teacher Leadership 2. Student Leadership.
Measurement & specification of various playing fields – Cricket, Volley Ball, Basket Ball, Badminton, Ball Badminton, Foot Ball, Hand Ball & their basic playing skills.

16 Hours

Course Outcomes:

At the end of the course, the student will be able to

1. Demonstrate an understanding of the principles and concepts related to a variety of physical activities.
2. Apply health and fitness principles effectively through a variety of physical activities.
3. Support and encourage others (towards a positive working environment).
4. Show self-motivation, organization and responsible behavior.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 1	PSO↓ 2
CO1						3			2	1		1		
CO2						3			2	1		1		
CO3						3			2	1		1		
CO4						3			2	1		1		
CO5						3			2	1		1		

1: Low 2: Medium 3: High

TEXT AND REFERENCE BOOKS:

i. A. K. Uppal, "Physical Education and Health"
ii. M. L. Kamlesh, "Fundamental Elements of physical Education",
iii. Swami Ramdev, "Yog its philosophy and practice", Divya Prakashan
iv. V. K. Sharma, "Health and Physical Education"

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INTRODUCTION TO JAPANESE LANGUAGE

Course Code	**21HU8X72**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department:

Course Objectives:

1.	Have basic spoken communication skills
2.	Write Simple Sentences
3.	Listen and comprehend basic Japanese spoken Japanese
4.	Read and understand basic Japanese characters including Kanji

UNIT - I	
(Lessons 1-6) **Grammar –** Introduction, Alphabets, Accents, Noun, Pronoun, Present Tense, Past tense **Vocabulary –** Numbers, Days, week days, months, Seasons, Nature, Dialogs and Video Clips	13
UNIT - II	
(Lessons 7-13) Communication skills – Time, Addective, Seasons, Conversation, Q&A Hobby, 5-W/1-H, Entering School/Company, Body Parts, Colours, Features etc**.**	13
UNIT - III	
(Lessons 14-20) Japanese Counting System, Birth/Death, Dialogs (Going to Party, Restaurant), My day, Success/Failure, Kanji Characters, and sentence making, Video Clips	13

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

1.	Understand Simple words, expressions and sentences, spoken slowly and distinctly
2.	Speak slowly and distinctly to comprehend
3.	Read and Understand common words and sentences
4.	Ask Basic questions and speak in simple sentences
5.	Write Hiragana/Katakana and Kanji (120) characters.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1						3			2	1		1		
CO2						3			2	1		1		
CO3						3			2	1		1		
CO4						3			2	1		1		
CO5						3			2	1		1		

1: Low 2: Medium 3: High

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SUSTAINABLE DEVELOPMENT GOALS

Course code	**21ME8X75**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

Sustainable Development Goals is a 2016 United Nations officially released Agendas for Sustainable approach environmental integrity, economic viability and a just society for present and future generations. It aims to provide the knowledge, skills, attitudes and values necessary to address sustainable development challenges. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. Learn more and take action. This SDG program is organized in such a way to be research-led, applied interdisciplinary program that considers sustainability in both developed and developing societies, and addresses critical global challenges put forth by UN.

UNIT – I

The origin, development and idea of the SDGs

History and origins of the Sustainable Development Goals. What are the SDGs? What are their aims, methodology and perspectives? How are they related to the Millennium Development Goals?

SDGs and Society: Ensuring resilience and primary needs in society

In-depth discussion and analysis of goals related to poverty, hunger, health & well-being and education

13 Hours

UNIT – II

SDGs and Society: Strengthening Institutions for Sustainability

In-depth discussion and analysis of goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions

SDGs and the Economy: Shaping a Sustainable Economy

In-depth discussion and analysis of goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption

13 Hours

UNIT – III

SDGs and the Biosphere: Development within Planetary Boundaries

In-depth discussion and analysis of goals related to clean water, climate, life below water and life on land

Realizing the SDGs: Implementation through Global Partnerships

In-depth discussion and analysis of SDG 17 which aims to implement the SDGs through partnerships, finance, technology and the development of coherence between policies.

13 Hours

Course Outcomes:

At the end of the course the student will be able to

CO 1	Summarize the UN's Sustainable Development Goals and how their aims, methodology and perspectives.
CO 2	Analyze the major issues affecting sustainable development and how sustainable development can be achieved in practice.
CO 3	Identify and apply methods for assessing the achievement/possibilities of sustainable development in Nitte gram panchayath.
CO 4	Evaluate the implications of overuse of resources, population growth and economic growth and sustainability & Explore the challenges the society faces in making transition to renewable resource use
CO 5	Create skills that will enable students to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development.

TEXTBOOKS:

1. Sachs, Jeffrey D. The age of sustainable development. Columbia University Press, 2015
2. Gagnon, B., Leduc, R., and Savard, L., Sustainable development in engineering: a review of principles and definition of a conceptual framework. Cahier de recherche / Working Paper 08-18, 2008.
3. Dalby, Simon, et al. Achieving the Sustainable Development Goals: Global Governance Challenges. Routledge, 2019.
4. Sustainability: A Comprehensive Foundation by Tom Thesis and JonathanTomkin, Editors.

REFERENCE BOOKS:

1. Elliott, Jennifer. An introduction to sustainable development. Routledge, 2012.
2. Day, G.S., and P.J.H. Schoemaker (2011), Innovating in uncertain markets: 10 lessons for green technologies, MIT Sloan Management Review, 52.4: 37-45.

MOOC Resources:

1. https://www.un.org/sustainabledevelopment/poverty/

Course Articulation Matrix

Course Code / Name : 21ME/ SUSTAINABLE DEVELOPMENT GOALS														
Course Outcomes (CO)	**Program Outcomes (PO)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**1**	**1**	**1**		**2**	**1**	**1**
2	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**2**	**1**	**1**		**1**	**1**	**1**
3	**3**	**2**	**2**	**1**	**1**	**3**	**3**	**2**	**3**	**1**		**1**	**1**	**2**
4	**3**	**2**	**3**	**1**	**1**	**3**	**3**	**2**	**1**	**1**		**1**	**3**	**2**
5	**1**	**2**	**2**	**1**	**1**	**3**	**3**	**2**	**2**	**2**		**1**	**1**	**1**

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi &contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I**&**Unit – II** and **1** full question from **Unit – III**.

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INTERNET OF THINGS – (IoT)			
Course Code	**21CS8X80**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to:

1. Learn the IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Describe IoT logical and physical design concepts
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

UNIT – I

Introduction

Introduction to IoT : Definition and characteristics, Physical design, Logical design, Enabling technologies, Levels and deployment templates, Examples: Domain specific IoTs, IoT Design and System Engineering, Discuss IoT Requirements, Hardware & Software; Study of IoT sensors, Tagging and Tracking, Embedded Products; IoT Design, (U) SIM Card Technology, IoT Connectivity and Management, IoT Security & IoT Communication.

(Text Book-1:, Chapter 1 to 4)

15 Hours

UNIT – II

Design Concepts:

IoT Logical Design:

Data types, Data structures, Control flow, Functions, Modules, Packages, File Handling, Date and time operation, Classes, Python packages of IoT, IoT Physical Design, Basic building blocks, Raspberry Pi, Linux on Raspberry Pi, Interfaces, Programming on Raspberry Pi with Python, Arduino Based IoT Project Implementation, Arduino for Project development, Internet enabled Arduino powered garage door opener, Irrigation control system, Light controller Message, controller and cloud Services

(Text Book-1: Chapter 4,5,6 ,7)

15 Hours

UNIT – III

09 Hours

Raspberry Pi based IoT Project Implementation:

Raspberry Pi for Project Development: Raspberry Pi platform, GPIO, Establishment and setting, of Raspberry Pi software, LAMP project, Home temperature, monitoring system, Webcam and Raspberry Pi camera project

(Text Book-1: Chapter 10,11,12, 13

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire the fundamental knowledge of IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Design IoT logical and physical architecture
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

Table-2: Mapping Levels of COs to POs / PSOs															
COs	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1						1	1			1		3	
CO2	2	3						1	1			1		3	
CO3	3	1						1	1			1		3	
CO4	3	2			3			1	1			1	1	3	3
CO5	3	2			3			1	1			1	1	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach,Vijay Madisetti", 2014.
2. Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", 1st Edition, McGraw Hill, 2015.

REFERENCE BOOKS:

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
2. Pethuru Raj and Anupama C. Raman,"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
3. Jeeva Jose," Internet of Things", Khanna Publishing House, Delhi
4. Adrian McEwen," Designing the Internet of Things", Wiley
5. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
6. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media

E-Books / Online Resources:

1. Object-Oriented Analysis and Design with Applications, Grady Booch, Robert A. Maksimchuk, Michael W. Engel, Bobbi J. Young, Jim Conallen, Kelli A. Houston, Third Edition The Addison-Wesley Object Technology Series, 2007
2. Object-Oriented Modelling and Design with UML, James R Rumbaugh, Michael R. Blaha Pearson Education, 21-Nov-2011
3. Object-Oriented Analysis and Design, Ramnath, Sarnath, Dathan, Brahma, ISBN 978-1-84996-522-4,, Springer Publications, 2011.

MOOC:

1. https://www.coursera.org/specializations/internet-of-things
2. https://www.udemy.com/course/iot-internet-of-things-automation-using- raspberry-pi/
3. https://www.udemy.com/course/arduino-iot-cloud/

SEE SCHEME:

There will be **8** questions of **20** marks each in the question paper divided into**3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III.**

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SOFTWARE ENGINEERING PRACTICES			
Course Code	**21IS8X83**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students:

1. Outline software engineering principles and activities involved in building large software programs.
2. Explain the importance of architectural decisions in designing the software.
3. Describe the process of Agile project development.
4. Recognize the importance of software testing and describe the intricacies involved in software evolution.
5. Identify several project planning and estimation techniques and explain the importance of software quality.

UNIT – I

Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Case Studies.
Software Processes: Models: Waterfall Model, Incremental Model and Spiral Model; Process activities.
Requirements Engineering: Functional and non-functional requirements, Requirements engineering processes, Requirements Elicitation and Analysis, Requirements specification, Software requirements document, Requirements validation & management.

15 Hours

UNIT – II

System Models: Context models, Interaction models, Structural models, Behavioral models.

T Architectural Design: Architectural design decisions. Architectural Views and patterns, Application architectures.

Design and implementation: Object oriented Design using UML.

Agile Software Development: Agile methods, Plan-driven and agile development, Extreme Programming, Agile project management.

15 Hours

UNIT – III

Project Management: Risk management, Teamwork.

Project Planning: Software pricing, Plan-driven development, Project Scheduling

Quality Management: Software quality, Reviews and inspections, Software measurement and metrics, Software standards.

9 Hours

Course Outcomes:

Students will be able to:

Sl. No.	Course Outcomes
1.	Recognise the basics of software system, component, process and Software Requirement Specification to meet desired needs within realistic constraints and outline the professional and ethical responsibility
2.	Describe the waterfall, incremental and iterative models and architectural design in implementing the software
3.	Make use of the techniques, skills, modern engineering design tools and agile methods necessary for engineering practice.
4.	Describe the methods for maintaining software system.
5.	Discuss project planning and management and illustrate the quality of software products

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
IS2504-1.1		3	1					2					1	2
IS2504-1.2	1	3	1										1	2
IS2504-1.3	1	1	3										2	3
IS2504-1.4	1	3	2										1	2
IS2504-1.5	1	2	2										1	2

1: Low 2: Medium 3: High

TEXTBOOK:

1. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education, 2012. 82Syllabus of III & IV Semester B.E. / Computer Science &Engg.

REFERENCE BOOKS:

1. Roger S. Pressman: "Software Engineering-A Practitioners approach", 7th Edition,Tata McGraw Hill, 2017.
2. Pankaj Jalote: "An Integrated Approach to Software Engineering", Wiley, India, 2010.

E-RESOURCES

1. http://agilemanifesto.org/
2. http://www.jamesshore.com/Agile-Book/
3. https://www.mooc-list.com/course/uml-class-diagrams-software-engineering-edx
4. https://www.mooc-list.com/course/enterprise-software-lifecycle-management-edx

SEE Question Paper Pattern:

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2**fullquestions from **Unit-I & Unit – II** and **1**fullquestion from **Unit– III.**

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INTRODUCTION TO CYBER SECURITY			
Course Code	**21IS8X84**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students:

1. Define the area of cybercrime and forensics.
2. Explain the motive and causes for cybercrime, detection and handling.
3. Investigate Areas affected by cybercrime.
4. Illustrate tools used in cyber forensic

UNIT – I

Introduction to Cybercrime: Cybercrime- Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cyber Crimes. **[T1: 1.1-1.5]**

Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing. **[T1: 2.1-2.8].**

Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops. **[T1:3.1-3.12]**

14 Hours

UNIT – II

Tools and methods used in Cybercrime:
Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. **[T1: 4.1-4.12]**

Phishing and Identity Theft Introduction to Phishing, Identity Theft (ID Theft). **[T1: 5.1-5.3]**

12 Hours

UNIT – III

UNDERSTANDING COMPUTER FORENSICS

Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics. **[T1: 7.1-7.19]**

13 Hours

Course Outcomes:

Students will be able to:

Sl. No.	Course Outcome
IS2503.1	Comprehend the Cybercrime and its origin
IS2503.2	Analyse the cybercrimes in mobile and wireless devices
IS2503.3	Apply tools and methods used in Cyber crimes
IS2503.4	Analyse Phishing and and ID Theft
IS2503.5	Comprehend Digital Forensics

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
IS2503-1.1	2					1		3						
IS2503-1.2		3		1		2			2					
IS2503-1.3		3	2										2	3
IS2503-1.4	2					2								
IS2503-1.5								3						

(L/1 = Low 30%-49%, M/2 = Medium 50%-69%, H/3=High >70%)

TEXTBOOKS:

1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013.

REFERENCE BOOKS:

1. Thomas J. Mowbray, "Cyber security: Managing Systems, Conducting Testing, and Investigating Intrusions", Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1.
2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec 2010. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw-Hill.

SEE Question Paper Pattern:

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2**fullquestions from **Unit-I & Unit – II** and **1**fullquestion from **Unit– III.**

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SPACETECHNOLOGYANDAPPLICATIONS			
Course Code	**21EC8X85**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Understand the general laws governing satellite orbits and its parameters.
2. Discuss effect of space environment on satellite signal propagation.
3. Illustrate various segments employed in satellite and ground station.
4. Calculate the uplink/downlink sub system characteristics.
5. Know the effects on the EM waves in propagation through space.
6. Explain the satellite launch in the space and their applications in remote sensing.
7. Discussthethedifferentcommunicationsystemsusedforsatelliteaccess.
8. Summarise Advanced space systems for mobile communication, VSAT, GPS.

UNIT – I

Satellite communications: Introduction, Kepler's laws, definitions, orbital element, apogeeandperigeeheights, orbit perturbations, inclined orbits.

Space environment: Earth's Atmosphere, Ionosphere and Meteorological effects on space systems, propagation of signal, Transmission losses in space environment.

Satellite Technology: Space segment, Ground segment, Quality and Reliability, Satellite Communication systems, Antennas.

15 Hours

UNIT – II

LaunchVehicles: Working,stages,Fuel,payloadprotection,Navigation,guidanceandcontrol,Reliability,launchingi ntoouter space and launch bases. Types of launch vehicles.

Space Applications: Digital DBS TV, DBS-TV System Design, Master Control Station and Uplink Antennas. Introduction, Radio and Satellite Navigation,

Remote Sensing: Introduction to Remote Sensing, Concepts and Applications of satellite Remote sensing.

14 Hours

UNIT – III

Satellite Access: Introduction, Single Access, Pre-assigned FDMA, Demand-Assigned FDMA, Spade system.

Advancedspacesystems: Satellitemobileservices,VSAT,Radarsat,orbitalcommunication**.**GlobalPositioning Satellite System (GPS).

10 Hours

Course Outcomes:

At the end of the course student will be able to

1. Discuss the fundamental principles of Satellite communication systems.
2. Discuss the Propagation impairments of satellite link.
3. Explain various segments employed in satellite and ground station.
4. Discuss the satellite launch mechanism and roll of those satellite in remote sensing.
5. Explain the different communication systems used for satellite access and list the recent satellites that have been launched for mobile communication, GPS.

Course Outcomes:

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

High Assessment Details (both CIE and SEE)

TheweightageofContinuousInternalEvaluation(CIE)is50%andforSemesterEndExam(SEE)is50%.The student must obtain minimum of 20 marks out of 50 in CIE and 20 marks out of 50 in SEE and 40%intotaltoobtainapassgrade.Semester End Exam(SEE)is conducted for 100 marks (3Hoursduration). Based on this grading will be awarded.

Continuous Internal Evaluation:

1. **Methods recommended:** Two Tests (80%), Written Quiz (16%) and module assignments (4%).Course coordinator will announce the evaluation procedure at the beginning of the semester and will be recorded in the course plan.

Semester End Examination:

1. There will be 8 questions of 20 marks each in the question paper categorized into 3 Units as per the syllabi & contact hours. The student will have to answer 5 full questions, selecting 2 full questions each from Unit- I& Unit–II and 1fullquestion from Unit– III.

TEXTBOOKS:

T1. Dennis Roddy, **"Satellite Communications"**, McGraw Hill 1996.
T2.TimothyPratt,**"SatelliteCommunications"**,WileyIndiaLtd,2006.
T3.KRamamurthy,**"RocketPropulsion"**,McMillanPublishersIndiaLtd,2010.

REFERENCE BOOKS:

R1. George Joseph, **"Fundamentals of Remote Sensing"**, Universities press, India 2003.
R2.BC Pande, **"Remote sensing and Applications"**, VIVA Books pvtltd, 2009.
R3. Meynart Roland, **"Sensors systems and next generation satellites"**, SPIE Publication.
R4.Thyagarajan ,**"Space Environment"**, ISRO Hand Book Publication.

E-Books / MOOC:

https://nptel.ac.in/courses/101106046

MARKETING MANAGEMENT			
Course Code	**21ME8X88**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Understand and learn the marketing concepts and their application to profit-orientedand non-profit oriented organizations.
2. Able to apply the marketing concepts to analyze the buying behavior & marketing segments to solve these problems.
3. Understand and learn the need for a customer orientation in product pricing & marketing research in the competitive global business environment;
4. Able to develop an understanding and acquiring skills in how to successfully design and implement marketing plans and strategies.
5. Understand and learn the concept of sales, advertising &distribution of marketing mix and its application in traditional and novel environments characterized by emerging information technologies.

UNIT - I

BASICS

Definition, Marketing Process, Dynamics, Needs, Wants & Demands, Marketing Concepts, Environment, mix, types, philosophies, Selling Vs. Marketing, organization, Industrial Vs. Consumer Marketing, Consumer goods, Industrial goods, Product hierarchy.

8 Hours

BUYING BEHAVIOUR & MARKET SEGMENTATION

Cultural, Demographic factors, Motives, types, Buying decisions, segmentation factors, Demographic, Psychographic & Geographic Segmentation, Process, Patterns.

8 Hours

UNIT - II

PRODUCT PRICING & MARKETING RESEARCH

Objectives, pricing, Decisions and Pricing methods, Pricing Management. Introduction,Uses, process of Marketing Research.

8 Hours

MARKETING PLANNING & STRATEGY FORMULATION

Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids.

8 Hours

UNIT - III

ADVERTISING, SALES PROMOTION & DISTRIBUTION

Characteristics, Impact, goals, types, Sales promotion-Point of Purchase, Unique Selling proposition.

Characteristics, Wholesaling, Retailing, channel design, logistics, Modern Trends inretailing.

7 Hours

Course Outcomes (CO):

At the end of the course the student will be able to

CO1	Explain the basic marketing concepts
CO2	Interpret the buying behaviour of customers and role of marketing segments
CO3	Explain the role of product pricing and marketing research in the competitiveglobal business environment
CO4	Analyse the marketing plans and strategies.
CO5	Explain the role of sales, advertising and distribution in marketing to achieve the goals ofmarketing

TEXTBOOK:

1. Govindarajan. M. 'Modern Marketing Management', Narosa Publishing House, NewDelhi, 1999

REFERENCE BOOKS:

1. Philip Kolter, " Marketing Management: Analysis, Planning, Implementation and Control ", 1998.
2. Green Paul.E. and Donald Tull, " Research for Marketing
3. Ramaswamy.V.S. and S.Namakumari, " Decisions ", 1975.
4. Jean Plerre Jannet Hubert D Hennessey Global Marketing, Environment: Planning, Implementation and Control the Indian Context ", 1990

NEXT GENERATION WIRELESS NETWORKS

Course Code	**21CC8X94**	**CIE Marks**	50
Number of Contact Hours/Week	**3:0:0**	**SEE Marks**	50
Total Number of Contact Hours	**39**	**Exam Hours**	03

Credits – 3

UNIT - I	**Contact Hours**
Historical Trend for Wireless Communication- Mobile Communications Generations: 1G to 4G – Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities -Use cases and Requirements – System Concept **5G Architecture**: Software Defined Networking – Network Function Virtualization – Basics about RAN Architecture –High-Level Requirements for 5G Architecture – Functional Architecture and 5G Flexibility – Physical Architecture and 5G Deployment.	15
UNIT - II	
Massive Multiple-Input Multiple –Output Systems : MIMO in LTE – Single-user MIMO – Multi-user MIMO – Capacity of Massive MIMO – Pilot Design of Massive MIMO. **D2DCommunications**: from4Gto5G–Radio Resource Management for Mobile Broadband D2D–Multi-hop D2D Communications for Proximity and Emergency Services – Multi-operator D2D Communication.	15
UNIT – III	
Wi-Fi 6 Protocol and Network: Introduction Wi-Fi Generations 1 to 5 Overview Wi-Fi Generation 6 (802.11ax) Wi-Fi6 and 5G 60 GHz Wi-Fi , Introduction to 6G and Networks	9
<u>Course Outcomes:</u> Upon completion of this course, students will be able to: 1.Describe and explain the evolution of 5G, system concepts and spectrum challenges 2.Illustrate and explain the 5G functional and physical architecture and its requirements 3 Illustrate and explain the fundamentals, resource allocation and transceiver algorithms for Massive MIMO 4.Describe and explain the requirements and fundamental techniques for D2DCommunication 5. Understand, Implement, explain the Wi-Fi 6 Protocol and Network	
TEXTBOOKS: • Asif Oseiran, JoseF. Monserratand Patrick Marsch, "5GMobile and Wireless Communications Technology,"Cambridge University Press,2016 • Jonathan Rodriquez, "Fundamentalsof5GMobileNetworks," Wiley, 2015 Sundar Gandhi Sankaran, Susinder Rajan Gulasekaran, **Wi-Fi 6 Protocol and Network, Artech House, 2021**	
REFERENCE BOOK: • Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long Term Research", Wiley, 2018	

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INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	**21AI8X95**	**CIE Marks**	**50**
Number of Contact Hours/Week	**3:0:0**	**SEE Marks**	**50**
Total Number of Contact Hours	**40**	**Exam Hours**	**03**

Credits – 3

Course Learning Objectives:

This Course will enable students to:

1. Understand the history of AI and machine learning.
2. Learn principles and algorithms of supervised learning.
3. Explain various applications of Techniques in association analysis.
4. Use different unsupervised learning techniques to solve the problem specification.
5. Understand the methods of parametric and non-parametric methods on real time data analysis and combined learners.

UNIT – I	**Hours**
Introduction to AI: what is AI, Acting Humanly: The Turing Test approach, Thinking Humanly: The cognitive modelling approach, thinking rationally: The laws of thought approach, Acting Rationally: The rational agent approach. The state of art **Branches Of Artificial Intelligence:** Machine Learning, Deep Learning, Natural Language Processing, Robotics, Expert Systems, Fuzzy Logic. **Intelligent Agents:** Agents and Environments, Good behavior: The concept of rationality, The nature of environments, properties of task environments, Structure of Agents: Agent Programs, Types of agent programs. **Solving Problems by Searching:** Problem solving Agents, well defined problems and solutions, formulating problems, Example problems: Toy problems: Vacuum world, 8-Queen's problem, Real world problem: Airline Route finding problem **Textbook 1: Chapter 1, 2 ,3** **Foundations of Machine Learning** What is machine learning? Applications of Machine learning, Understand Data. **Types of machine learning:** Supervised, Unsupervised, Reinforcement Learning. **Supervised Learning:** Linear Regression: Introduction, univariate linear regression, multivariate linear regression, regularized regression, Logistic regression, Support Vector Machines. Artificial Neural Networks. **Textbook: Chapter 1 , 2.** **Classification:** Preliminaries; General approach to solving a classification problem; Confusion Matrix, Decision tree induction, how decision tree works, Hunt's algorithm, Design issues, Methods for expressing attribute test conditions, Measures for selecting best fit, Algorithm for decision tree induction; Rule-based classifier: How rule-based classifier works, Rule ordering schemes, Nearest-neighbor classifier: Selecting K value, KNN algorithm. **Textbook 3: Chapter 4, 5** Tutorials: 1. Handling the missing values using orange tool. 2. Visualize: Scatter Plot (for univariate), Scatter Plot Matrix (for multivariate) using orange tool. **3.** iris classification using different algorithm.	15

UNIT - II	
Unsupervised Learning: **Association Analysis–1:** Problem definition, Frequent item set generation, Apriori principle, Candidate generation and pruning, Rule Generation in Apriori algorithm. **Association Analysis – 2:** FP-Growth algorithm, Evaluation of association patterns, Effect of skewed support distribution, Sequential patterns. **Cluster Analysis:** Different types of clustering: Hierarchical vs partitional, Exclusive vs overlapping, Fuzzy clustering, Complete vs partial. Types of clusters: Well separated, Prototype based clusters, Graph based clusters, Density based clusters, Conceptual clusters, K-means clustering algorithm, centroids and objective functions, Choosing initial centroids, time space complexity of K-means, K-means additional issues, Strengths and weakness of k-means, Agglomerative hierarchical clustering,	15

Key issues in hierarchical clustering, Strengths and weaknesses, DBSCAN algorithm. **Textbook 3: Chapter 6, 7, 8, 9.** Tutorials: 1. Diabetes classification using orange tool. 2. Association analysis using orange tool. **3.** Trying different evaluation matrix using orange tool.	
UNIT – III	
Parametric Methods: Introduction, Maximum Likelihood Estimation, Bernoulli Density, Multinomial Density, Gaussian (Normal) Density, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification **Nonparametric Methods**: Introduction, Nonparametric Density Estimation, Histogram Estimator, Kernel Estimator, k-Nearest Neighbor Estimator, Generalization to Multivariate Data, Nonparametric Classification, Condensed Nearest Neighbor. **Textbook 2: Chapter 4, 8.**	10
Course Outcomes: Upon completion of this course, students will be able to: 1. Basics of AI, branches of AI and ML. 2. Develop an appreciation for what is involved in learning models from supervised learning and algorithms on classification. 3. Apply association analysis on structured data. 4. Apply different unsupervised learning techniques to solve the problem specification. 5. Interpret methods of parametric and non-parametric methods on real time data analysis and know the combined learning.	
TEXTBOOKS: 1. Stuart Russel and Peter Norvig, "Artificial Intelligence A Modern Approach", Pearson 3rd Edition, 2016. 2. Introduction to Data Mining-Pang-NingTan, Michael Steinbach,Vipin Kumar, Pearson Education, 2009. 3. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, 2004.	
REFERENCE BOOKS: 1. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997. 2. R. O. Duda, P. E. Hart and D. G. Stork Pattern Classification, Wiley Publications, 2001 3. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008. 4. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012. 5. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012. 6. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012. 7. S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.	

MICRO AERIAL VEHICLES

Course Code	**21RI8X91**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**(3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**50**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**3**

Course Learning Objectives:

This Course will enable students to:

- Comprehend the basic aviation history and UAV systems.
- Acquire the knowledge of basic aerodynamics and performance.
- Understand the stability and control air vehicles
- Understand the propulsion, loads and structures.
- Develop and test the remote controlled, autonomous aerial vehicles

UNIT - I

Introduction Aviation History and Overview of UAV systems, Definitions and Terminology, **Classification of UAV's,** Classes and Missions of UAVs, UAV fundamentals, Examples of UAV systems-very small, small, Medium and Large UAV

The Air Vehicle

Basic Aerodynamics:

Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, Induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag

Performance:

Overview, climbing flight, Range and Endurance – for propeller-driven aircraft, range- a jet-driven aircraft, Guiding Flight. **15 Hours**

Pedagogy	Chalk and talk, Power point presentation,

UNIT - II

Stability and Control

Overview, Stability, longitudinal, lateral, dynamic stability, Aerodynamics control, pitch control, lateral control, Autopilots, sensor, controller, actuator, airframe control, inner and outer loops, Flight-Control Classification, Overall Modes of Operation, Sensors Supporting the Autopilot.

Propulsion Overview, Thrust Generation, Powered Lift, Sources of Power, The Two-Cycle Engine, The Rotary Engine, The Gas Turbine, Electric Motors, and Sources of Electrical Power. Loads and Structures Loads, Dynamic Loads, Materials, Sandwich Construction, Skin or Reinforcing Materials, Resin Materials, Core Materials, Construction Techniques. **15 Hours**

Pedagogy	Chalk and talk, Power point presentation,

UNIT - III

Mission Planning and Control: Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads.

Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Trade-offs

9 Hours

Course outcome (Course Skill Set)

At the end of the course student will be able to

1. Explain the basics of aerodynamics performance and apply the basic concepts of UAV systems and experimentally study the integration of drones.
2. Explain the stability and control required for UAV and Select the propulsion system, materials for structures.
3. Develop and test remote controlled autonomous aerial vehicles. Experimental study on remote controlled and autonomous UAV.
4. Design air vehicles for different payloads and design standards. Experimental study on autonomous and remote-controlled Vertical Take-off and Landing UAV
5. Develop and test rotary wing aerial vehicles. Experimental study on Unmanned aerial vehicles and fixed wing UAV

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End

Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). CIE for Theory is for 50 marks and CIE for Lab component is 50marks. The final CIE for these IPCC courses is for 50 marks with 60% weightage of theory & 40% weightage of lab component CIE.

Theory Component	
MSE I	20 Marks
MSE II	20 Marks
Task-I	5 Marks
Task-II	5 Marks
Total	50 Marks

Semester End Examination:

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

Suggested Learning Resources:

BOOKS:

1. Paul Gerin Fahlstrom, Thomas James Gleason, Introduction to UAV Systems, Wiley Publication, 4th Edition,2012.
2. **Landen Rosen, Unmanned Aerial Vehicle, Alpha Editions**
3. Unmanned Aerial Vehicles: DOD's Acquisition, Alpha Editions
4. **Valavanis, Kimon P , Unmanned Aerial Vehicles , Springer, 2011**
5. Valavanis, K., Vachtsevanos, George J , Handbook of Unmanned Aerial Vehicles , Springer, 2015.

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc22_me38/preview

COURSE ARTICULATION MATRIX:

Course Code / Name : / Micro Aerial Vehicles															
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
	3	2	1	-	-	-	-	-	-	-	-	-	2	-	2

1: 1ow 2: Medium 3: High

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SUSTAINABILITY ENGINEERING

Course Code:	**21CV8X96**	**CourseType:**	**OE**
Teaching Hours/Week (L:T:P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**39**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Civil Engineering

Course Objectives: This Course will enable students to:

1.	Understand the relevance, the concept and the role of engineers in sustainable development
2.	Understand green building concepts, materials, certifications, and sustainable practices through case studies in sustainability engineering.
3.	Master Life Cycle Assessment principles for environmental, social, and economic analysis in engineering applications.

4.	Enable students to understand and apply sustainability reporting frameworks like GRI, Dow Jones, and prepare comprehensive sustainability reports.
5.	Develop skills to integrate sustainability principles into civil engineering design processes, employing sustainable strategies and measuring sustainability effectively.

UNIT - I

Sustainable Development

Sustainable development- Need- various agreements and Role of Engineering- Sustainable Development and Engineering Profession. Sustainable Engineering concepts, Goals of Sustainability, System Thinking, Life cycle Thinking and circular economy

Green Building: Concept, green building materials, green building certification and rating: green rating for integrated habitat assessment (GRIHA) , leadership in energy and environmental design (LEED) rating, energy efficient buildings, sustainable cities, sustainable transport, sustainable pavements, case studies in sustainability engineering: Green building, sustainable city, sustainable transport system

15 Hours

UNIT - II

Fundamentals of Life Cycle Assessment

Energy systems, Buildings and the Built Environment, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Softwares, Strength and Limitations of LCA. Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, **LCA Applications in Engineering:** Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing,

Sustainability Reporting: GRI, Dow Jones Sustainability Index, Analysis and Research; Prerequisites of a sustainability Report, structure of a sustainability Report, Case Study: Sustainability Report Preparation.

15 Hours

UNIT - III

Integrating Sustainability in Civil Engineering Design:

Integrating Sustainability in Engineering Design: Problems Solving in Engineering, conventional to Sustainable Engineering Design Process, Design for Life Guidelines and Strategies, Measuring Sustainability, Sustainable Design through sustainable procurement criteria, Case studies on sustainable Engineering Design Process – Sustainable Process Design, Sustainable construction planning and Design, sustainable materials design in Civil Engineering.

09 Hours

Course Outcomes: At the end of the course students will

1.	Be proficient in applying sustainable engineering concepts, integrating system and life cycle thinking to address global challenges in the engineering profession.
2.	Adeptly apply green building principles, materials, certifications, and sustainability engineering case studies to contribute effectively to sustainable urban development.
3.	Master Life Cycle Assessment principles for comprehensive engineering analysis, integrating environmental, social, and economic dimensions effectively.
4.	skillfully prepare sustainability reports using GRI standards and Dow Jones Sustainability Index, applying theoretical knowledge to practical case studies for effective reporting.
5.	Adeptly integrate sustainability principles into civil engineering design, applying life cycle strategies and sustainable procurement criteria through case studies analysis.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes															
-1.1															
-1.2															
-1.3															
-1.4															
-1.5															

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Sreenivasan Sundarrajan, (2018). "Sustainable Development: Principles, Frameworks, and Practices", Springer
2.	S. S. Bhavikatti , (2016). "Sustainable Engineering: Concepts and Applications" Publisher: I.K. International Publishing House Pvt. Ltd.

3.	Gaurav Biswas, (2019). " Engineering Sustainable Communities: Principles and Practices ", CRC Press
4.	"Green Buildings Pay" by Brian W. Edwards (2013, TERI Press)
5.	"Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes" by Sam Kubba (2017, Butterworth-Heinemann)
6.	"Life Cycle Assessment: Theory and Practice" Bhupendra Kumar Sharma 2017 TERI Press
7.	"Life Cycle Assessment: Principles, Practice and Prospects" Author: R. K. Goel Publisher: TERI Press Year of Publication: 2017
8.	"Sustainability Reporting: GRI, Dow Jones Sustainability Index, Analysis and Research" Author: Zabihollah Rezaee Publishing Year: 2017 Publisher: John Wiley & Sons
9.	"Sustainable Engineering: Concepts, Design and Case Studies" by David T. Allen, 2019, Wiley.
E Books / MOOCs/ NPTEL	
1.	https://onlinecourses.nptel.ac.in/noc24_de01/preview; Strategies for Sustainable Design.
2.	https://onlinecourses.nptel.ac.in/noc24_hs77/preview; Energy Resources, Economics, and Sustainability;