श्रीचन्द्रशेखरेन्द्रसरस्वतीविश्वमहाविद्यालयः

SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA

Deemed to be University u/s 3 of UGC Act 1956 | Accredited with "A" grade by NAAC

Enathur, Kanchipuram - 631 561. Tamilnadu, India

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Sponsored and run by Sri Kanchi Kamakoti Peetam Charitable Trust

B.E – CIVIL ENGINEERING – PART TIME

श्री गुरुभ्यो नमः

HUMBLE PRANAMS

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B.E – CIVIL ENGINEERING

(PART TIME)

CURRICULUM – 2020 ONWARDS

FOR CANDIDATES ADMITTED DURING THE YEAR 2018 ONWARDS

(CHOICE BASED CREDIT SYSTEM)

DEPARTMENT VISION AND MISSION

VISION

- The Civil Engineering aims at providing accessible and relevant programs that are directly applicable to the dynamic environment, in which our students will work, live and contribute.

MISSION

- To produce high profile future Civil Engineering experts, endowed with high quality knowledge of Construction and other areas , sufficiently capable of proving their professional mettle in the present-day competitive world with confidence.

PROGRAMME OBJECTIVES

- **PEO: I** To impart science-based engineering education to develop professional skills that will prepare the students for immediate employment in relevant branch of engineering in industry as against the model that just prepares them for post-graduate education.
- **PEO 2**: To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in range of professions.
- **PEO 3:** To develop among students the awareness of and the competence to be savvy users of information technology.
- **PEO 4**: To develop among students the ability to work with others, in professional and social settings.
- **PEO 5:** To develop a global view among students so that they can appreciate diversity in the world and in intellectual pursuits and the desire and ability to keep learning throughout life.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

For a graduate study in Civil engineering

- Plan, analyse, and design infrastructural projects and its components in various areas of Civil Engineering like Structural Engineering, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, and Transportation Engineering.
- Execute the construction of buildings and other components of various projects in Civil Engineering including its layout, management, and quality control.
- Implement the provisions made in Indian Standard Codes/ other relevant codes/ specifications/ guidelines and applicable laws including labour laws and environmental laws.

PROGRAMME OUTCOMES

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, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science 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 modelling 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 principle 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 and 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.

Choice Based Credit System for B.E PART TIME (CIVIL) Programme

Credits

For a course with three credits three lecture hours are assigned per week additionally with one tutorial hour, so a three credit course has three plus one hour per week. Lab courses are assigned with two credits. Each semester curriculum shall normally have a blend of theory and practical courses. He or she have to serve for at least one year or enroll as a student member of a recognized professional society / chapter / Association. The total credit is 104.

Duration of the Programme

A student is normally expected to complete BE PART TIME (Civil Engineering) Programme in 3.5 years but in any case, not more than seven years from the time of admission.

Registration for Courses

A newly admitted student will automatically be registered for the entire course prescribed for the first year without any option. Every other student should submit a completed registration form indicating the list of course intended to be credited during the next semester. This registration will be done in a week before the last working day of the current semester. Late registration with the approval of the department along recommendation of the head of the department along with a late fee will be done up to the last working day. Registration for the project work shall be done only for the final semester.

Assessment

The break – up of assessment and examination marks for the theory subjects is as follows:

First Assessment	: 15 marks
Final Assessment	: 15 marks
Assignments	: 10 marks
Examination	: 60 marks

The break – up of assessment and examination marks for the Practical subjects is as follows:

First Assessment	: 15 marks
Final Assessment	: 15 marks
Maintenance of record book	: 10 marks
Examination	: 60 marks

The project work marks comprises of two components. One component will be assessed by the committee, consisting of the guide and a minimum of two members nominated by the Head of the Department. The project work has to be carried out by the student in Project phase I will have a credit of 10 totaling to 12 credits for project. One of the committee members will be nominated as the chairman by the head of the department. The head of the department may himself be a member or the chairman. The second component marks for the project work will be decided by viva voice examination at the end of the semester.

Student Mentor

To help the students in planning the course of study and for general advice on the academic programme, the head of the department will attach a certain number of students to a member of faculty who shall function as student mentor for those students throughout their period of study. Such student mentors shall advice the student, preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the head of the department.

Class Committee

For all the branches of study during the first year, a common class committee will be constituted by the dean of the faculty among the various teachers teaching the common subject to different classes during the first year, the dean shall appoint one of them as course coordinator. The composition of the first year class committee will be as follows.

- Course coordinators of all common courses.
- Teachers of all other individual courses.

All heads of the departments, among whom one may be nominated as chairman by the dean. The Dean may opt to be a member or the chairman. For each of the higher semester, separate class committees will be constituted by the head of the department. The composition of the class committees from third to eighth semesters will be as follows.

Class In charge for the particular class shall be the Class Committee Coordinator .Along with him / her the committee should have all the faculties handling the respective subjects for the class and two students representatives .The Report of the Class committee meeting must be sent to Head of the Department for any remedial actions.

A project coordinator (for the Seventh only) who shall be appointed by the head of the department among the project supervisors, teachers of other individual courses.

One professor or reader, preferably not teaching the concerned class appointed as chairman by the head of the department.

The head of the department may opt to be a member of chairman.

All the student counselors of the class and the head of the department (if not already a member) or any staff member nominated by the head of the department may opt to be special invitees. The class committee shall meet four times during the semester.

The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc., for the first assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion the first assessment to review the performance and for follow – up action.

The third meeting will be held within a week after the final assessment is completed to review the performance and for the follow – up action.

The fourth meeting will be held after all the assessments are completed for all the courses and at least one week before on the commencement of the examinations. During the meeting, assessment in a maximum of 40 marks will be finalized for every student and tabulated and submitted to the head of the

department (to the dean in the case of first year) for approval and submitted to the controller of examinations.

Withdrawal from a course

A student can withdraw from a course at any time before a date fixed by the head of the department prior to the final assessment, with the approval of the dean of the faculty on the recommendation of head of the department.

Temporary Break of Study

A student can take a one – time temporary break of study covering the current year / semester and /or the next semester with the approval of head of the department, not later than seven days after completion of the mid – semester test. However, the student must complete the entire programme within the maximum period of seven years.

Substitute Arrangement

A students who has missed the examination for genuine reason, may take a substitute assessment for any one of the missed reasons accepted by the head of the department, one or more assessments of a course. The substitute assessment must be completed before the date of the fourth meeting of the respective class committees. A student who wishes to have a substitute assessment for a missed assessment must apply to the head Of the department within a week from the date of the missed assessment.

Attendance Requirements

To be eligible to appear for the examination in a particular course, a student must put in minimum of 80% in the course. However, if the attendance is 70% or above but less than 80% in any course, the authorities can permit the student to appear for the examination in the course on payment of the prescribed condition fees. A student who withdraws from or does not meet the minimum attendance requirement in course must re-register and repeat the course.

Passing and Declaration of Examination Results

All assessments of all the courses on absolute marks basis will be considered and passing by the results passing board in accordance with the rules of the university. Thereafter, the controller of examinations shall convert marks for each course to the corresponding letter grade as follows, Compute the grade point average and cumulative grade point average, and prepare the grade cards.

90 to 100 marks	: Grade ‘S’	Insufficient Attendance	: Grade ‘I’
80 to 89 marks	: Grade ‘A’	Withdrawn from course	: Grade ‘W’
70 to 79 marks	: Grade ‘B’		
60 to 69 marks	: Grade ‘C’		
55 to 59 marks	: Grade ‘D’		
50 to 54 marks	: Grade ‘E ’		
Less than 50 marks	: Grade ‘F’		

A student who obtains less than 24 marks out of 60 in the examination or absent for the examination will be awarded a s grade 'F'.

A student who earns a grade of S, A, B, C, D, or E for a course is declared to have successfully completed that course and earned credits for that course. Such a course cannot repeated by the student. A student who obtains letter grade F in a course has to reappear for the examinations in that course.

A student who obtains letter grade I or W in a course has to re -register and repeat the course.

The following grade points are associated with each letter grade and repeat the point average and Cumulative grade point average.

S - 10; A - 09; B - 08; C - 07; D - 06; E - 05; F - 0.

Course with grades I and W is not considered for calculation of grade point average or cumulative grade point average. F grade will be considered for computing GPA and CGPA.

A student can apply for re - totaling for one or more of his/her examination answer papers within a week from the date of issue of the grade sheet to the students on payment of prescribed fee per paper. The application must be made to the controller of Examinations with the recommendation of head of the department.

After results are declared, grade cards will be issued to the students. The grade cards will contain the list of courses registered during the year / semester, the grades scored and the grade point average (GPA) for the year / semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the year/ semester, divided by the sum of the number of credits for all courses taken in that year / semester. CGPA is similarly calculated considering all the courses taken from the time of admission.

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

- For First Class the student should obtain a CGPA of 6.5 and above in 5 years from the time of admission.
- For Second Class the student must complete degree within seven years from the time of admission.
- The student should eligible to get B.E (Honors) if He or She complete an additional 20 credits. This credit should be earned through MOOCS / Swayam.

SPECIALIZATION IN B.E. CIVIL DEGREE PROGRAMME

- Construction Engineering
- Structural Engineering
- Environmental Engineering
- Remote Sensing and GIS
- Geotechnical Engineering
- Transportation Engineering

DEFINITION OF CREDIT

Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical(Lab)/week	1 credit

COURSE CODE AND DEFINITION:

COURSE CODE	DEFINITIONS
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Programme Core Courses
PEC	Professional Elective Courses
LC	Laboratory Course
PIIC	Project / Industrial Practice / Internship

CREDIT DISTRIBUTION:

SL.NO	CATEGORY	CREDITS
1.	Basic Science Courses(BSC)	12
2.	Engineering Science Courses (ESC)	3
3.	Programme Core Courses (PCC)	61
4.	Professional Elective Courses (PEC)	18
5.	Project / Industrial Practice / Internship (PIIC)	10
Total Credits		**104**

B.O.S MEMBERS

SL.NO.	NAME OF THE MEMBER	DESIGNATION	ADDRESS
1.	Dr.N.Seshadri Sekhar	Chairman	Professor & HOD, Dept. of Civil Engineering, SCSVMV
2.	Dr.G.Sriram	Representative for Hon'ble VC	Dean(E&T), SCSVMV
3.	Dr.G.Kesavan	Internal Member	Assistant Professor, Dept. of Civil Engineering, SCSVMV
4.	Mrs.R.Sumathi	Internal Member	Assistant Professor, Dept. of Civil Engineering, SCSVMV
5.	Dr.K.Ambiga	Internal Member	Assistant Professor, Dept. of Civil Engineering, SCSVMV
6.	Prof. Dr.Mallikarjuna,	External Expert	Dean (Engineering), Dept of Civil Engineering, SV University, Tirupathi .
7.	Dr.Sthaladipti Saha.	External Expert	Vice President & Head- Public Space & Airports SBG at Larsen & Toubro Limited. Chennai.
8.	Mr. S.Jayachandran	Alumini Student	Project Coordinator, VGN Infra India Pvt.Ltd., Chennai.

CURRICULUM FOR FULL TIME B.E (CIVIL) PART TIME

(For candidates admitted during the year 2020 onwards)

SEMESTER – I

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP181T10	Mathematics - I(Calculus, Multivariable Calculus and Linear Algebra)	BSC	3	1	0	4	40	60	100
2.	BCEP181T20	Engineering Mechanics	ESC	2	1	0	3	40	60	100
3.	BCEP181T30	Fluid Mechanics	PCC	2	1	0	3	40	60	100
4.	BCEP181T40	Solid Mechanics	PCC	2	1	0	3	40	60	100
5.	BCEP181T50	Concrete Technology	PCC	3	0	0	3	40	60	100
			Total	**12**	**4**	**0**	**16**	**-**	**-**	**500**

SEMESTER –II

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP182T10	Mathematics - II (Differential Equations & Numerical Methods)	BSC	3	1	0	4	40	60	100
2.	BCEP182T20	Hydraulic Engineering	PCC	2	1	0	3	40	60	100
3.	BCEP182T30	Geotechnical Engineering	PCC	2	1	0	3	40	60	100
4.	BCEP182T40	Structural Mechanics - I	PCC	2	1	0	3	40	60	100
Laboratory										
5.	BCEP182P50	Geotechnical Engineering Laboratory	PCC	0	0	3	2	40	60	100
			Total	**9**	**4**	**3**	**15**	**-**	**-**	**500**

SEMESTER –III

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP183T10	Mathematics-III (Probability Theory and Statistics)	BSC	3	1	0	4	40	60	100
2.	BCEP183T20	Hydrology & Water Resources	PCC	3	0	0	3	40	60	100
3.	BCEP183T30	Transportation Engineering	PCC	3	0	0	3	40	60	100
4.	BCEP183T40	Structural Mechanics - II	PCC	2	1	0	3	40	60	100
Laboratory										
5.	BCEP183P50	Transportation Engineering Laboratory	PCC	0	0	3	2	40	60	100
			Total	**11**	**2**	**3**	**15**	**-**	**-**	**500**

SEMESTER –IV

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP184T10	Design of Concrete Structures -I	BSC	2	1	0	3	40	60	100
2.	BCEP184T20	Design of Steel Structures	PCC	2	1	0	3	40	60	100
3.	BCEP184E1A – 1F	Professional Elective Course I	PEC	3	0	0	3	40	60	100
4.	BCEP184E2A-2F	Professional Elective Course II	PEC	3	0	0	3	40	60	100
Laboratory										
5.	BCEP184P50	STADD PRO lab	PCC	0	0	3	2	40	60	100
			Total	**10**	**2**	**3**	**14**	**-**	**-**	**500**

SEMESTER –V

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP185T10	Environmental Engineering I	PCC	3	0	0	3	40	60	100
2.	BCEP185T20	Remote Sensing& GIS	PCC	3	0	0	3	40	60	100
3.	BCEP185E3A-3G	Professional Elective Course III	PEC	3	0	0	3	40	60	100
4.	BCEP185E4A-4D	Professional Elective Course IV	PEC	3	0	0	3	40	60	100
Laboratory										
5.	BCEP185P50	Remote Sensing& GIS Laboratory	PCC	0	0	3	2	40	60	100
			Total	**12**	**0**	**3**	**14**	**-**	**-**	**500**

SEMESTER –VI

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP186T10	Design of Concrete Structures -II	PCC	2	1	0	3	40	60	100
2.	BCEP186T20	Environmental Engineering II	PCC	3	0	0	3	40	60	100
3.	BCEP186T30	Estimation, Costing & Valuation	PCC	2	1	0	3	40	60	100
4.	BCEP186E5A-5F	Professional Elective Course V	PEC	3	0	0	3	40	60	100
Laboratory										
5.	BCEP186P50	Revit Architecture Lab	PCC	0	0	3	2	40	60	100
			Total	**10**	**2**	**3**	**14**	**-**	**-**	**500**

SEMESTER –VII

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BCEP187T10	Construction Engineering & Management	PCC	3	0	0	3	40	60	100
2.	BCEP187E6A-6G	Professional Elective Course VI	PEC	3	0	0	3	40	60	100
Laboratory										
3.	BCEP187P30	Project Work - Phase I	P I	0	0	12	10	40	60	100
			Total	**6**	**0**	**12**	**16**	**-**	**-**	**300**

BCEP

Total Credits: 104

SUMMARY OF CREDIT DISTRIBUTION

Sl.No.	Course	Semester							Total
		I	II	III	IV	V	VI	VII	
1.	BSC	4	4	4	-	-	-	-	**12**
2.	ESC	3	-	-	-	-	-	-	**3**
3.	PCC	9	11	11	8	8	11	3	**61**
4.	PEC	-	-	-	6	6	3	3	**18**
5.	P I	-	-	-	-	-	-	10	**10**
6.	TOTAL	**16**	**15**	**15**	**14**	**14**	**14**	**16**	**104**

AICTE RECOMMENDATIONS

Sl.No.	CATEGORY	CREDITS [AICTE]	CREDITS [SCSVMV- EEE]
1.	Basic Science Course (BSC)	**25**	**12**
2.	Engineering Science Courses (ESC)	**24**	**3**
3.	Programme Core Courses (PCC)	**48**	**61**
4.	Professional Elective Courses (PEC)	**18**	**18**
5.	Project/ Industrial Practice/ Internship (PIIC)	**15**	**10**
	Total Credits	**130**	**104**

LIST OF PROFESSIONAL ELECTIVES COURSES [PEC]

Professional Elective Course– I [Geotechnical Engineering]

A. Foundation Engineering
B. Geotechnical Design
C. Offshore Engineering
D. Rock Mechanics
E. Environmental Geo-technology
F. Ground improvement techniques

Professional Elective Course – III [Construction Engineering & Management]

A. Building Construction Practice
B. Construction Project Planning & Systems
C. Sustainable Construction Methods
D. Contracts Management
E. Repairs & Rehabilitation of Structures

Professional Elective Course – III [Transportation Engineering]

A. Pavement Design
B. Public Transportation Systems
C. Traffic Engineering and Management
D. Urban Transportation Planning
E. Geometric Design of Highways
F. Highway Construction and Management
G. Railway Engineering

Professional Elective Course – IV [Hydraulics, Hydrology & Water Resources Engineering]

A. Design of hydraulic structures
B. Irrigation Engineering
C. Groundwater Engineering
D. Surface water hydrology

Professional Elective Course – V [Structural Engineering]

A. Wood Structures
B. Masonry Structures
C. Structural Analysis by Matrix Methods
D. Pre stressed Concrete
E. Industrial Structures
F. Earthquake Engineering

Professional Elective Course – VI [Environmental Engineering]

A. Ecological Engineering
B. Rural Water Supply and Onsite Sanitation Systems
C. Water and Air Quality Modeling
D. Solid and Hazardous Waste Management
E. Air and Noise Pollution and Control
F. Environmental Impact Assessment and Life Cycle Analyses

FIRST SEMESTER

Course Code:	Mathematics - I(Calculus, Multivariable Calculus and Linear Algebra)	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: BSC		3	1	0	4	SEE Marks **60**

COURSE OBJECTIVES:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, differential equations and sequence and series.
- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics.

COURSE OUTCOMES:

- The objective of this course is to familiarize the prospective engineers with techniques in basic calculus, analysis and numerical computations.
- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

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

Cos No.	Course Outcomes	Bloom's level
CO1	To Perform matrix operations. Solve the matrix equation using elementary matrix operations. To use systems of linear equations and matrix equations to determine linear dependency or independency. To find the eigenvalues and corresponding eigenvectors for a linear transformation.	Remembering Applying Evaluating
CO2	To understand the concept of convergence and divergence and their testing that is fundamental to application of analysis to Engineering problems. To understand the convergence and divergence of infinite series	Applying Understanding Analysing
CO3	To Compute partial derivatives, derivatives of vector-valued functions, gradient functions. Evaluate integrals of functions or vector-related quantities over curves, surfaces, and domains in two- and three-dimensional space. To evaluate partial derivatives and can implement to estimate maxima and minima of multivariable function.	Remembering Applying Evaluating

CO4	To deal with functions of several variables that are essential in most branches of engineering. The mathematical tools needed in evaluating multiple integrals and their usage. Use double, triple and line integrals in applications.	Applying Evaluating
CO5	To apply Fundamental Theorem of Line Integrals, Green's Theorem, Stokes' Theorem, or Divergence Theorem to evaluate integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.	Remembering Applying Evaluating

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	S	-	-	S	-	-	S	S	-
CO2	S	-	-	S	S	S	S	-	-	-	S	S
CO3	-	S	-	S	-		-	S	-	S	-	-
CO4	S	-	-	-	S	S	-	-	-	S	-	S
CO5	-	S	-	S	-	-	-	S	-	S	-	-

SYLLABUS:

MODULEI

MATRIX

Symmetric- Skew-symmetric- Orthogonal matrices - Eigen values and Eigenvectors - Cayley-Hamilton Theorem - Diagonalization of Matrices - Orthogonal transformation and Quadratic to Canonical forms.

MODULE II

SEQUENCE & SERIES

Convergence of sequence and series - tests for convergence - Comparison test - D'Alembert's ratio test - Raabe's test - Cauchy's root test - Fourier series: Half range sine and cosine series - Parseval's theorem.

MODULE III

MULTIVARIABLE CALCULUS – DIFFERENTIATION

Evolutes and Involutes - Partial derivatives - Total derivative - Maxima, Minima and Saddle points - Vector differentiation: Directional Derivatives - Tangent Plane and Normal line - Gradient, Divergence and Curl - Solenoidal - Irrotational.

MODULE IV

MULTIPLE INTEGRALS

Multiple Integration - Double and Triple integrals (Cartesian and polar) - Change of order of integration in double integrals - Applications of definite integrals to evaluate surface areas and volumes of revolutions.

MODULE V

VECTOR INTEGRATION
Theorems of Green, Gauss and Stokes (without proof) - Beta and Gamma functions and their properties

LEARNING RESOURCES:

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers,43rd Edition Jan 2010.

References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson, 9th Edition Jan 2010.
2. T. Veerarajan, Engineering Mathematics, McGraw-Hill, New Delhi, 3rd Edition 2011.
3. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill, New Delhi, 2010.
4. N.P. Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications,9th Edition 2016.
5. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.

Course Code:	**ENGINEERING MECHANICS**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category:		3	1	0	4	SEE Marks **60**

COURSE OBJECTIVES:

- To learn about the concept of moment of forces and its application
- To know the concepts of Equilibrium of rigid bodies

COURSE OUTCOMES:

- Determine the Equilibrium of System of Forces**,** Equilibrium of System of Forces.
- Solve Equilibrium in three dimensions; Method of Sections; Method of Joints, to determine if a member is in tension or compression.

- Apply various methods of Area moment of inertia, Moment of inertia of plane sections from first principles, Theorems of moment of inertia.
- Determine Virtual displacements, principle of virtual work for particle and ideal system.
- Apply various methods of Area moment of inertia, Moment of inertia of plane sections from first principles, Theorems of moment of inertia.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Determine the Equilibrium of System of Forces, Equilibrium of System of Forces.	Determine
CO2	. Solve Equilibrium in three dimensions; Method of Sections; Method of Joints, to determine if a member is in tension or compression.	Solve
CO3	Apply various methods of Area moment of inertia, Moment of inertia of plane sections from first principles, Theorems of moment of inertia.	Apply
CO4	Determine Virtual displacements, principle of virtual work for particle and ideal system	Determine
CO5	Apply various methods of Area moment of inertia, Moment of inertia of plane sections from first principles, Theorems of moment of inertia.	Analyze

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	L	-	-	L	-	-	-	M	-	-
CO2	M	S	-	-	-	-	-	-	-	-	L	L
CO3	S	-	S	-	-	-	-	-	-	-	-	-
CO4	S	S	-	M	-	M	-	-	-	-	-	-
CO5	S	S	-	-	S	L	M	-	M	S	-	-

SYLLABUS:

MODULE I

INTRODUCTION

Force Systems Basic concepts, equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System.

EQUILIBRIUM OF SYSTEM OF FORCES

Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

MODULE II

EQUILIBRIUM OF RIGID BODIES

Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines

IMPULSE AND MOMENTUM

Concept of conservation of momentum- Impulse-Momentum principle- Impact-Direct central impact-oblique central impact.

MODULE III

CENTROID AND CENTRE OF GRAVITY

Centroid of simple figures from first principle, Centroid of composite sections; Centre of Gravity and its implications;

MOMENT OF INERTIA

Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

MODULE IV

FRICTION

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

VIRTUAL WORK AND ENERGY METHOD

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

MODULE V

REVIEW OF PARTICLE DYNAMICS

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.

KINETICS AND KINEMATICS OF PARTICLES

Basic terms, general principles dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

LEARNING RESOURCES:

Text Books:

1. Bansal R.K.(2010), A Text Book of Engineering Mechanics, LaxmiPublications
2. Hurmi R.S. (2010), Engineering Mechanics, S. Chand &Co.
3. Reddy Vijay Kumar K. and K. Suresh Kumar (2010), Singer's EngineeringMechanics

References:

1. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
2. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics,Pearson Press.
3. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics,Oxford
4. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, PrenticeHall
5. Shames and Rao (2006), Engineering Mechanics, PearsonEducation,

Course Code:	**FLUID MECHANICS**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: **PCC**		2	1	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce the concepts of fluid mechanics useful in Civil Engineering applications.
- To provide a first level exposure to the students to fluid statics, kinematics and dynamics and measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. To impart knowledge on the fundamentals and the behavior of fluids at rest.
- To understand the behavior of fluids in motion
- To learn the mechanism of fluid flow through pipes.
- To assess the boundary layer flow in fluids.
- To gain knowledge on dimensional homogeneity and similitude.

COURSE OUTCOMES:

- Understand the fundamentals of Fluid mechanics and gain knowledge in fluid statics
- Understand and Apply the concepts of fluid kinematics and dynamics
- Apply and analyse the different losses that occur in fluid flow and its computation
- Exposure to boundary layer flow.
- Apply the concept of dimensional homogeneity and model laws.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Understand the fundamentals of Fluid mechanics and gain knowledge in fluid statics	Understand
CO2	Understand and Apply the concepts of fluid kinematics and dynamics	Apply
CO3	Apply and analyse the different losses that occur in fluid flow and its computation	Apply
CO4	Exposure to boundary layer flow.	Analysis
CO5	Apply the concept of dimensional homogeneity and model laws.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	M	-	-	-	-	-	-	-	-
CO2	M	M	-	S	-	-	-	-	-	-	-	-
CO3	M	M	L	S	M	-	-	-	-	-	-	-
CO4	M	M	M	S	M	-	-	-	-	-	-	-
CO5	M	M	M	M	S	-	-	-	-	M	-	M

SYLLABUS:

MODULE I

DEFINITIONS AND FLUID PROPERTIES

Basic Concepts and Definitions – Distinction between a fluid and a solid, Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity, variation of viscosity with temperature, Newton law of viscosity, vapour pressure, boiling point, cavitation; surface tension, capillarity, , compressibility. Fluid Statics-Pressure measurement by manometers and pressure gauges. Total and Centre of Pressure. Hydrostatic pressure and Pascal's law. Forces on horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies

MODULE II

FLUID KINEMATICS AND FLUID DYNAMICS

Classification of fluid flows, Stream line, path line, streak line and stream tube; stream function velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian co ordinates. Equations of motion - Euler's equation, Bernoulli's equation – derivation, Energy Principle,

Practical applications of Bernoulli's equation, venturimeter, orifice meter and Pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow

MODULE III

FLOW THROUGH PIPES

Reynold's experiment-Viscous flow - Shear stress, pressure gradient relationship – laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) – Hydraulic and energy gradient. Flow through Pipes: Loss of head through pipes, Darcy Weisbach equation minor losses, Pipes in series, pipes in parallel.

MODULE IV

BOUNDARY LAYER THEORY

Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary- Layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate. Laminar sub-layer, smooth and rough boundaries. Separation and Control.

MODULE V

DIMENSIONAL ANALYSIS

Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Rayleigh's method and Buckingham's π-Theorem.

LEARNING RESOURCES:

Text Books:

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi. 2003
2. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 2001.
3. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 5th edition, Laxmi Publications Pvt. Ltd, New Delhi, 2008.

References:

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 2000.
2. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 1995.
3. Jain A. K. "Fluid Mechanics", Khanna Publishers, 2010
4. Roberson J.A and Crowe C.T., "Engineering Fluid Mechanics", Jaico Books Mumbai, 2000.
5. White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5th Edition, New Delhi, 2003.

Course Code:	SOLID MECHANICS	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce to continuum mechanics and material modeling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.
- The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modeling and design of a large range of engineering materials.
- The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system.
- The behavior of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material.
- These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behavior is carefully observed and measured. For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics.

COURSE OUTCOMES:

- Describe the concepts and principles, understand the theory of elasticity including strain/ displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.
- Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods.
- Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams.
- Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading;
- Apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.	Understand
CO2	Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical	Analysis

	methods and energy methods.	
CO3	Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams.	Apply
CO4	Calculate the deflection at any point on a beam subjected to a combination of loads;solve for stresses and deflections of beams under unsymmetrical loading;	Analysis
CO5	Apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	L	M	M	---	---	---	M	M	L	M
CO2	S	S	M	M	M	---	---	---	L	L	L	L
CO3	M	S	L	L	S	---	---	----	L	L	L	L
CO4	M	S	S	L	M	---	---	---	L	L	L	M
CO5	S	M	M	M	L	---	---	---	L	M	L	M

SYLLABUS:

MODULE I

SIMPLE STRESSES AND STRAINS

Simple Stresses and Strains- Concept of stress and strain, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them –Bars of varying section – composite bars – Temperature stresses.

MODULE II

COMPOUND STRESSES AND STRAIN ENERGY

Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain. Strain Energy – Resilience– Gradual, sudden, impact and shock loadings – simple applications.

MODULE III

SHEAR FORCE AND BENDING MOMENT

Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.
Slope and deflection- Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection

MODULE IV

THEORY OF BENDING

Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses –Section modulus of rectangular and circular sections (Solid and Hollow), I,T, and Channel sections – Design of simple beam sections.
Shear Stresses- distribution across various beam sections like rectangular, circular, triangular, I, T sections.

MODULE V

TORSION AND THIN CYLINDER

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts. Analysis of close-coiled-helical springs. Thin Cylinders and Spheres- calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

LEARNING RESOURCES:

Text Books:

1. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials”, DVNC, New York, USA.
2. Kazmi, S. M. A., “Solid Mechanics” TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979

References:

1. Laboratory Manual of Testing Materials - William Kendrick Hall
2. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.
3. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi

CourseCode:	CONCRETE TECHNOLOGY	L	T	P	Credit	CIA Marks **40**
Course Category:		3	1	0	4	SEE Marks **60**

COURSE OBJECTIVES:

To impart knowledge to the students on the properties of materials for concrete by suitable tests, mix design for concrete and special concretes

COURSE OUTCOMES:

The various requirements of cement, aggregates and water for making concrete

- The effect of admixtures on properties of concrete
- The concept and procedure of mix design as per IS method
- The properties of concrete at fresh and hardened state
- The importance and application of special concretes.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy	Identify
CO2	Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete	Apply
CO3	Evaluate the effect of the environment on service life performance, properties and failure modes of structural concrete and demonstrate techniques of measuring the Non Destructive Testing of concrete structure	Evaluate
CO4	Develop an awareness of the utilization of waste materials as novel innovative materials for use in concrete	Develop
CO5	Design a concrete mix which fulfills the required properties for fresh and hardened concrete	Design

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	-	-	-	L	L	-	-	M	-	-
CO2	M	S	-	-	-	-	-	-	-	-	L	L
CO3	S	-	S	-	-	-	-	-	-	-	-	-
CO4	S	S	-	M	-	M	-	-	-	-	-	-
CO5	S	S	-	-	S	L	M	-	M	S	-	-

SYLLABUS:

MODULE I
CONSTITUENT MATERIALS

Cement – Different types – Chemical composition and Properties – Hydration of cement – Tests on cement – IS Specifications – Aggregates – Classification -Mechanical properties and tests as per BIS – Grading requirements – Water – Quality of water for use in concrete.

MODULE II
CHEMICAL AND MINERAL ADMIXTURES

Accelerators – Retarders – Plasticizers – Super plasticizers – Water proofers – Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline – Effects on concrete properties.

MODULE III
PROPORTIONING OF CONCRETE MIX

Principles of Mix Proportioning – Properties of concrete related to Mix Design – Physical properties of materials required for Mix Design – Design Mix and Nominal Mix – BIS Method of Mix Design -Mix Design Examples.

MODULE IV
FRESH AND HARDENED PROPERTIES OF CONCRETE

Workability – Tests for workability of concrete – Segregation and Bleeding – Determination of strength Properties of Hardened concrete – Compressive strength – split tensile strength – Flexural strength – Stress-strain curve for concrete – Modulus of elasticity – durability of concrete – water absorption – permeability – corrosion test – acid resistance.

MODULE V
SPECIAL CONCRETES

Light weight concretes – foam concrete- self compacting concrete – vacuum concrete – High strength concrete – Fibre reinforced concrete – Ferrocement – Ready mix concrete – SIFCON - Shotcrete – Polymer concrete – High performance concrete – Geopolymer Concrete

LEARNING RESOURCES:

Text Books:

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.

2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003

3. Bhavikatti.S.S, " Concrete Technology", I.K.International Publishing House Pvt. Ltd., New Delhi, 2015

4. Santhakumar. A.R., "Concrete Technology", Oxford University Press India, 2006.

References:

1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 1995

2. Gambhir, M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007

3. IS10262-2009 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.

4. Job Thomas, "Concrete Technology", Cengage Learning India Pvt. Ltd., Delhi, 2015

5. Kumar P Mehta., Paulo J M Monterio., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education (India) Private Limited, New Delhi, 2016

SECOND SEMESTER

Course Code:	MATHEMATICS - II (Differential equations, Numerical Methods)	L	T	P	Credit	CIA Marks **40**
Course Category: BSC		3	1	0	4	SEE Marks **60**

COURSE OBJECTIVES:

- To provide an overview of Ordinary differential equations and Partial differential equations.
- To introduce the concept of Numerical methods and solving ODE and PDE using Numerical methods.

COURSE OUTCOMES:

- They understand the concept of operator D in Ordinary differential equations of higher order and the rules for solving it. They know how to use method of variations of parameters and how to reduce the given equations into linear equation with constant coefficients.
- They Know how to form the Partial differential equations and the methods to solving it.
- They identify the concept of homogeneous and non-homogeneous linear partial differential equations and to solve second and higher order by complementary functions and particular integral method. The understand its applications in engineering problems.
- Analyzing the basic concept of Numerical methods and to find the solutions of algebraic and transcendental equations in various methods.
- They know to solve Ordinary differential equations using Numerical methods.

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

Cos No.	Course Outcomes	Bloom's level
CO1	They understand the concept of operator D in Ordinary differential equations of higher order and the rules for solving it. They know how to use method of variations of parameters and how to reduce the given equations into linear equation with constant coefficients.	Understanding, Analysing, Evaluating
CO2	They Know how to form the Partial differential equations and the methods to solving it.	Understanding , Analysing, Evaluating, create
CO3	They identify the concept of homogeneous and non-homogeneous linear partial differential equations and to solve second and higher order by complementary functions and particular integral method. The understand its applications in engineering problems.	Remembering , Applying Understanding, Evaluating
CO4	Analyzing the basic concept of Numerical methods and to find the solutions of algebraic and transcendental equations in various methods.	Applying Understanding, Analysing, Evaluating
CO5	They Know to solve Ordinary differential equations using Numerical methods.	Applying Understanding, Analysing, Evaluating

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	-	-	S	S	-	S	S	S	-	-	-
CO2	S	-	S	S	S	S	-	S	S	-	-	-
CO3	S	-	-	S	S	S	S	S	S	S	S	S
CO4	S	-	S	S	S	S	-	S	S	S	S	-
CO5	S	S	S	S	-	S	S	S	-	S	-	S

SYLLABUS:

MODULE I
ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS
Operator D – Rules for finding complementary function – Rules for finding particular Integral – Working procedure to solve the equation - Method of variation of parameters - Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation.

MODULE II
PARTIAL DIFFERENTIAL EQUATIONS – FIRST ORDER
Formation of partial differential equations – Solution of a partial differential equation – Equations solvable by direct integration – Linear equations of first order – Non linear equations of the first order

MODULE III
PARTIAL DIFFERENTIAL EQUATIONS – HIGHER ORDER
Solution to homogeneous and non-homogeneous linear partial differential equations second and higher order by complementary function and particular integral method.
Method of separation of variables – Vibration of a stretched string: Wave equation – Solution of Wave equation - D'Alembert's solution of wave equation – One dimensional heat flow – Solution of heat equation.

MODULE IV
NUMERICAL METHODS
Solution of algebraic and transcendental equations - Bisection method – Method of false position (Regula-Falsi Method) - Newton-Raphson Iterative method- Numerical integration: Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule.

MODULE V
NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS
Interpolation with equal intervals – Newton's forward interpolation formula – Newton's backward interpolation formula - Interpolation with unequal intervals: Lagrange's interpolation formula, Newton's divided difference formula. Picard's method – Taylor series method - Modified Euler's method – Runge's method – Runge-Kutta method – Predictor-corrector methods: Milne's method,

LEARNING RESOURCES:

Text Books:

1. Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 43rd Edition 2011.

References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. Chandrika Prasad, Advanced Engineering Mathematics, Khanna Book Publishing Co. (P)
3. Ltd., Delhi Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill
4. Sashtry, Advanced Engineering Mathematics (ISBN:9788120336094), PHI

Course Code:	**HYDRAULIC ENGINEERING**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		2	0	2	3	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines.
- At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

COURSE OUTCOMES:

- Apply their knowledge of fluid mechanics in addressing problems in open channels.
- Able to identify a effective section for flow in different cross sections.
- To solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
- Understand the principles, working and application of turbines.
- Understand the principles, working and application of pumps.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Apply their knowledge of fluid mechanics in addressing problems in open channels.	Understand
CO2	Able to identify an effective section for flow in different cross sections.	Analysis
CO3	To solve problems in uniform, gradually and rapidly varied flows in steady state conditions.	Apply
CO4	Understand the principles, working and application of turbines.	Analysis

CO5	Understand the principles, working and application of pumps.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	-	-	L	L	-	-	L	-	L
CO2	M	S	M	L	-	L	-	-	-	L	-	L
CO3	M	S	M	L	L	L	-	-	L	L	-	L
CO4	S	M	L	-	L	-	-	-	-	L	-	L
CO5	S	M	L	-	L	-	-	-	-	L	-	L

SYLLABUS:

MODULE I

OPEN CHANNEL FLOW

Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Specific energy, Specific energy curve, critical flow, discharge curve, Specific force, Specific depth and Critical depth.

MODULE II

UNIFORM FLOW

Characteristics of uniform flow, Measurement of Velocity- Current meter, Floats, Hot-wire

anemometer Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n .Most economical section of channel. Computation of Uniform flow, Normal depth.

MODULE III

NON-UNIFORM FLOW

Definition- Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by Direct Step method, Graphical Integration method and Direct integration method.

HYDRAULIC JUMP

Hydraulic jump – Types – Energy dissipation – Surges – Surge channel transitions

MODULE IV

TURBINES

Impact of Jet on flat, curved plates, Stationary and Moving –Classification of Turbines – Pelton wheel – Francis turbine – Kaplan turbine - Specific speed – Characteristic Curves of Turbines- Draft tube and cavitation.

MODULE V
PUMPS
Classification of Pumps - Centrifugal pumps – Work done - Minimum speed to start the pump - NPSH - Multistage pumps – Characteristics curve - Reciprocating pumps - Negative slip – Indicator diagrams and its variations – Air vessels - Savings in work done.

LEARNING RESOURCES:

Text Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open channel Flow, K. Subramanya, Tata McGraw Hill.

References:

1. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
2. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.

Course Code:	**GEOTECHNICAL ENGINEERING**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To estimate index properties of soils (coarse and fine)
- To estimate consistency limit of fine grained soils
- To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test,
- To estimate the engineering properties of the soils by density test, CBR test permeability test and consolidation test.

COURSE OUTCOMES:

- Carry out soil classification solve three phase system problems solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram

estimate the stresses under any system of foundation loads solve practical problems related to consolidation settlement and time rate of settlement.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Compute the basic properties of soils and classify the Soil according to AASHTO, USCS and IS soil classification system	Understand
CO2	Determine the Permeability of Cohesive and Cohesionless soils	Apply
CO3	Calculate Effective stress within soils and stress	Apply
CO4	Compute the Shear Strength of soils based on the parameters obtained from shear tests.	Apply
CO5	Estimate consolidation parameters and compute consolidation	Apply
CO6	Illustrate the significance of soil compaction and analyse stability of earth slopes	Apply

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	-	L	-	-	-	-	-	L	M	L
CO2	M	L	-	L	L	M	-	-	-	-	L	M
CO3	S	S	-	M	M	M	L	-	-	-	L	M
CO4	M	M	-	S	-	L	-	-	-	-	M	M
CO5	S	S	-	S	M	L	-	L	-	S	L	M
CO6	M	S	-	S	M	M	-	-	-	-	M	M

SYLLABUS:

MODULE I

PHYSICAL & INDEX PROPERTIES OF SOIL: Weight – Volume Relationships, In – situ Density, Moisture Content, Specific Gravity, Relative Density, Atterberg's Limits, Soil Indices, consistency of soil , Particle Size Distribution of soil: Sieving, Sedimentation Analysis. Identification & Classification of soil: Field identification of soil, Soil Classification: as per Unified Classification System, IS Code Recommendation as per SP 36 – 1 (1987).

MODULE II

FLOW THROUGH SOIL: Darcy's Law, Coefficient of permeability, laboratory and field determination of coefficient of permeability, Permeability for Stratified Deposits, Laplace's Equations, Flow nets, Flow through Earthen Dam, Estimation of Seepage, and Uplift due to seepage. Effective Stress Principles: Effective Stress, Effective pressure due to different conditions, Seepage force, Critical hydraulic gradient, quick sand condition, Design of filters, Capillarity in soil.

MODULE III

STRESS DISTRIBUTION IN SOIL: Normal and shear stresses, Stress due to point loads, Stress beneath Line, strip & uniformly loaded circular area & rectangular area, pressure bulbs, Newmark's charts – Use for determination of stress due to arbitrarily loaded areas.

MODULE IV

COMPACTION OF SOIL: Principles of Compaction, Compaction Test, Field Compaction, Various methods of field compaction and control. Compressibility & Consolidation of Soil: Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils: Compression index, Coefficient of compressibility & volume change, Coefficient of consolidation, Degree & rate of consolidation, Laboratory method of one dimensional consolidation test, Determination of consolidation parameters, Secondary consolidation.

MODULE V

SHEAR STRENGTH OF SOIL: Basic concepts, Mohr – Columb's Theory, Laboratory Determination of soil shear parameter – Direct Shear, Tri – axial Test, Unconfined Compression, Vane Shear Test, Sensitivity &thixotropy of clay as per SP 36 – 1 (1987). Slope failure mechanisms – total stress analysis for saturated clays – friction circle method, tension cracks – use of stability number.

LEARNING RESOURCES:

Text Books:

1. Dr.Punmia. B.C., "Soil Mechanics & Foundation Engineering", Lakshmi Publications, 2005.
2. Moorthy, V.N.S., "Soil Mechanics & Foundation Engineering", CRS Press, 2002. 71

References:

1 Arora, "Soil Mechanics & Foundation Engineering", Standard Publishers Distributors, 2005. 2 "Compendium of Indian Standards on Soil Engineering: Part – 1 Laboratory Testing of Soils for Civil", Bureau of Indian Standards, New Delhi.

3 Shamsher Prakash, "Problems in Soil Mechanics", Asia Publishing House, 1972.

4 Terzaghi, K. and Peck.R.B, "Soil Mechanics in Engineering Practice", John Wiley & Sons, 1996.

Venkataramaiah. C, "Geotechnical Engineering", New Age International Publishers, 2006.

Course Code:	STRUCTURAL MECHANICS I	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		2	1	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce the students to basic theory and concepts of structural analysis and the classical methods for the analysis of buildings.

COURSE OUTCOMES:

- Determine forces in members of trusses by method of joints.
- Draw influence line diagram for reaction, shear force and bending moment of determinate structures
- Analysis for influence lines of indeterminate structures
- Analyze determinate arches subjected to different loading.
- Analyse beams and frames by slope deflection method.
- Analyse beams and frames by moment distribution method.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Find the force in members of trussesby method of joints.	Understand
CO2	Analysis trusses, frames and arches	Analysis
CO3	Analyse structures for moving loads	Analysis
CO4	Analysisbeams and frames by slope deflection method.	Analysis
CO5	Types of arches and beams	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	-	-	L	-	-	-	M	-	S
CO2	M	M	-	-	-	-	-	-	-	-	L	M
CO3	S	S	-	-	-	-	-	-	-	-	-	S
CO4	S	S	-	M	-	M	-	-	-	-	-	S
CO5	S	S	-	-	M	L	M	-	M	S	-	S

SYLLABUS:

MODULE I

DEFLECTION OF DETERMINATE STRUCTURES

Principles of virtual work for deflections – Deflections of pin-jointed plane frames and rigid plane frames – Willot diagram - Mohr's correction.

MODULE II

INFLUENCE LINES AND ROLLING LOADS

Influence Line Diagram (ILD)-Definition – uses – ILD for shear force – ILD for B.M at a section of a simply supported beam.Rolling Loads – ILD for shear force and bending moment at a section - ILD for max. Shear force and bending moment - single concentrated load – UDL longer than the span – UDL shorter than the span – Two point loads separated by a distance apart - several point loads.

MODULE III

ARCHES

Arches as structural forms – Examples of arch structures – Types of arches – Analysis of three hinged, two hinged and fixed arches, parabolic and circular arches – Settlement and temperature effects.

MODULEIV

SLOPE DEFLECTION METHOD

Continuous beams and rigid frames (with and without sway) – Symmetry and antisymmetry – Simplification for hinged end – Support displacements

MODULE V

MOMENT DISTRIBUTION METHOD

Distribution and carryover of moments – Stiffness and carry over factors – Analysis of continuous beams – Plane rigid frames with and without sway – Neylor's simplification.

LEARNING RESOURCES:

Text Books:

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis – Vol. 1 & Vol. 2", Laxmi Publications Pvt. Ltd, New Delhi, 2003.

2. L.S. Negi& R.S. Jangid, "Structural Analysis", Tata McGraw Hill Publications, New Delhi, 6th Edition, 2003.

3. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, "Theory of structures", Laxmi Publications Pvt. Ltd., New Delhi, 2004

4. Reddy. C.S., "Basic Structural Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

5. BhavaiKatti, S.S, "Structural Analysis – Vol. 1 & Vol. 2", Vikas Publishing Pvt Ltd., New Delhi, 2008

References:

1. Wang.,C.K., " Indeterminate Structures" McGraw Hill Book Co., Newyork, 1994

2. Pandit G.S and Gupta S.P., "Structural Analysis – A Matrix Approach" Tata McGraw-Hill Publishing Ltd. New Delhi, 2007

3. Reddy,C.S., "Basic Structural Analysis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010

4. Junnarkar, S.B. & Shah, H.J.., Mechanics of structures, vol.I, II, Charotar Publishing House, India, 2000

5. Thandavamoorthy, ''Analysis of Structures", Oxford &IBH Publishers, New Delhi.2008

Course Code:	GEOTECHNICAL LAB	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		0	0	3	2	SEE Marks **60**

COURSE OBJECTIVES:

- To estimate index properties of soils (coarse and fine)
- To estimate consistency limit of fine grained soils
- To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test,
- To estimate the engineering properties of the soils by density test, CBR test permeability test and consolidation test.

COURSE OUTCOMES:

- To estimate the stresses under any system of foundation loads solve practical problems related to consolidation settlement and time rate of settlement.

SYLLABUS:

LIST OF THE EXPERIMENTS:

1. Grain Size analysis
2. Consistency limits
3. Specific gravity
4. Permeability tests
5. Unconfined compression test
6. Direct shear test
7. Core cutter and sand replacement
8. Compaction test
9. California bearing ratio test
10. Vane shear test
11. Triaxial test
12. Consolidation test.

LEARNING RESOURCES:

1. Dr.Punmia. B.C., “Soil Mechanics & Foundation Engineering”, Lakshmi Publications, 2005.

THIRD SEMESTER

Course Code:	MATHEMATICS III (Probability and Statistics)	L	T	P	Credit	CIA Marks **40**
Course Category: BSC		3	1	0	4	SEE Marks **60**

COURSE OBJECTIVES:

- To familiarize the students with statistical techniques.
- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

COURSE OUTCOMES:

Students who successfully complete this course should be able to demonstrate and understanding of:

Cos No.	Course Outcomes	Bloom's level
CO1	Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.	Remembering, Understanding Applying
CO2	How to derive the probability function of transformations of random variables and use these techniques to generate data from various distributions.	Remembering, Understanding Remembering, Understanding Applying
CO3	How to calculate and apply measures of location and measures of dispersion in grouped and ungrouped data cases.	Applying
CO4	Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.	Analyzing, Evaluating
CO5	How to translate real-world problems into probability models. Also how to collect data, analyze and deduce information from a real time survey without any unwilling bias	Evaluating , create

Mapping of Course Outcome to Program Outcomes:

COs/POs	Mapping of COs with POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	M	M	M	-	M	M	M	M
CO2	S	S	S	S	M	M	M	-	M	M	M	M
CO3	S	S	S	S	M	M	M	-	M	M	M	L
CO4	S	S	S	S	M	M	M	-	M	M	M	L
CO5	S	S	S	S	M	M	M	-	M	M	M	L

SYLLABUS:

MODULE I

BASIC PROBABILITY:

Probability spaces, conditional probability, Independent random variables, sums of independent random variables, Bayes' Theorem, Discrete and Continuous one dimensional random variables - Expectations, Moments, Variance of a sum, Moment generating function, Tchebyshev's Inequality.

MODULE II

PROBABILITY DISTRIBUTIONS:

Discrete Distributions – Binomial, Poisson and Negative Binomial distributions, Continuous Distributions - Normal, Exponential and Gamma distributions.

MODULE III

BASIC STATISTICS:

Measures of Central tendency: Averages, mean, median, mode, Measures of dispersion – Range, Mean deviation, Quartile deviation and Standard deviation, Moments, skewness and Kurtosis, Correlation and regression – Rank correlation.

MODULE IV

APPLIED STATISTICS:

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

MODULE V

SMALL SAMPLES:

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

LEARNING RESOURCES:

Text Books:

1. T. Veerarajan, Probability, Statistics and Random Processes, Third edition, Tata McGraw-Hill, New Delhi, 2010.
2. S.P. Gupta, Statistical Methods, 31st edition, Sultan chand and sons, New Delhi, 28th Edition 2002.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,10th Edition Dec 2010.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43th Edition 2000.
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 9th Edition 2013.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 9th Edition, 2015.

Course Code:	HYDROLOGY & WATER RESOURCES ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		2	0	2	3	SEE Marks **60**

COURSE OBJECTIVES:

- To study occurrence movement and distribution of water that is a prime resource for development of a civilization..
- To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.
- To know the basic principles and movement of ground water and properties of groundwater flow.

COURSE OUTCOMES:

- Provide a background in the theory of hydrological processes and their measurement
- Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management
- An ability to manipulate hydrological data and undertake widely-used data analysis.
- Can define the key components of a functioning groundwater, can determine the main aquifer properties – permeability, transmissivity and storage Identify geological formations capable of storing and transporting groundwater.
- Different methods and importance of rain water harvesting.

After learning the course the students should be able to:

COS NO.	Course Outcomes	Bloom's level
CO1	Provide a background in the theory of hydrological processes and their measurement	Understand
CO2	Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management	Apply

CO3	An ability to manipulate hydrological data and undertake widely-used data analysis.	Analysis
CO4	Can define the key components of a functioning groundwater, can determine the main aquifer properties – permeability, transmissivity and storage Identify geological formations capable of storing and transporting groundwater.	Understand, Analysis
CO5	Different methods and importance of rain water harvesting	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	S	M	L	L	M	S	S
CO2	M	M	M	L	L	M	M	M	L	M	S	M
CO3	L	L	L	M	S	L	L	L	M	M	S	S
CO4	L	S	---	L	---	S	S	M	L	M	S	M
CO5	L	M	L	L	M	M	M	L	L	L	M	M

SYLLABUS:

MODULE I

INTRODUCTION

Hydrologic cycle, Climate and water availability, Water balances, Precipitation: Forms, Classification, Variability, Measurement, Data analysis, Evaporation and its measurement, Evapo-transpiration and its measurement, Penman Monteith method. Infiltration: Factors affecting infiltration, Horton's equation and Green Ampt method.

MODULE II

HYETOGRAPH AND HYDROGRAPH ANALYSIS

Hyetograph, Runoff: drainage basin characteristics, Hydrograph concepts, assumptions and limitations of unit hydrograph, Derivation of unit hydrograph, S- hydrograph, Flow duration curve

Groundwater: Occurrence, Darcy's law, Well hydraulics, Well losses, Yield, Pumping and recuperation test

MODULE III

RESERVOIR AND HYDROELECTRIC POWER

Reservoir: Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity, Reservoir sedimentation and control. Introduction to Dams Introduction and types of dams, spillways and ancillary works, Site assessment and selection of type of dam, Information about major dams and reservoirs of India

Hydroelectric Power: Low, Medium and High head plants, Power house components, Hydel schemes

MODULE IV

FLOOD MANAGEMENT and HYDROLOGIC ANALYSIS

Flood Management: Indian rivers and floods, Causes of floods, Alleviation, Leeves and floodwalls, Floodways, Channel improvement, Flood damage analysis.

Hydrologic Analysis: Design flood, Flood estimation, Frequency analysis, Flood routing through reservoirs and open channels.

MODULE V

DROUGHT MANAGEMENT AND WATER HARVESTING

Definition of drought, Causes of drought, measures for water conservation and augmentation, drought contingency planning. Water harvesting: rainwater collection, small dams, runoff enhancement, runoff collection, ponds, tanks.

LEARNING RESOURCES:

Text Books

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill. New Delhi.

2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.

3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-

Graw Hill.

4. G L Asawa, Irrigation Engineering, Wiley Eastern

References:

1. L W Mays, Water Resources Engineering, Wiley.

2. J D Zimmerman, Irrigation, John Wiley & Sons

3. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

4. R.K. Sharma and T.K. Sharma, Hydrology and Water Resources Engineering, Prentice Hall of India, New Delhi.

Course Code:	TRANSPORTATION ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand about highway development in India, highway alignment.
- To understand about the design of the geometric elements of highways.
- To understand about the characteristics of pavement materials.
- To understand about design of flexible and rigid pavements.
- To understand about traffic studies, regulation and control measures and highway maintenance

COURSE OUTCOMES:

- Carry out surveys involved in planning and highway alignment
- Design the geometric elements of highways
- Characterize pavement materials
- Design flexible and rigid pavements as per IRC
- Carry out traffic studies and implement traffic regulation and control measures

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

COS NO.	Course Outcomes	Bloom's level
CO1	Carry out surveys involved in planning and highway alignment	Understand
CO2	Design the geometric elements of highways	Analysis
CO3	Characterize pavement materials	Apply
CO4	Design flexible and rigid pavements as per IRC	Analysis
CO5	Carry out traffic studies and implement traffic regulation and control measures	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	-	-	-	S	S	S	M	M	L	M
CO2	S	S	M	L	-	L	-	-	L	L	-	L
CO3	M	S	-	L	-	M	L	-	L	L	-	L

CO4	M	S	S	L	-	L	L	-	L	L	L	M
CO5	L	-	-	M	-	S	S	L	L	M	-	M

SYLLABUS:

MODULE I

HIGHWAY DEVELOPMENT AND PLANNING

Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

MODULE II

GEOMETRIC DESIGN OF HIGHWAY

Geometric design of highways-: Introduction; highway cross section elements; sight distance, stopping sight distance, over taking sight distance, design of horizontal alignment; design of vertical alignment; problems

MODULE III

PAVEMENT MATERIALS

Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements.

MODULE IV

DESIGN OF PAVEMENT

Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements-components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC;

MODULE V

TRAFFIC ENGINEERING AND CONTROL

Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; road intersections; parking facilities; highway lighting. Highway maintenance. Pavement evaluation.

LEARNING RESOURCES:

Text Books:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering.
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley

References:

1. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
2. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

Course Code:	**STRUCTURAL MECHANICS II**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		2	1	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce the students to advanced methods of analysis like matrix methods, and FE method and also analysis of space structures.
- Fundamentals of strength of materials and mechanics of solids.

COURSE OUTCOMES:

- Analyze Determinate and Indeterminate structures by flexibility matrix method.
- Analysis of continuous beam, pin-jointed plane frames and rigid frames by stiffness matrix method.
- Basic concepts of stresses, strains and Equilibrium equations.
- Analyze Truss element and Beam element by FEM
- Analysis of Space trusses using method of tension coefficients.

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

COS NO.	**Course Outcomes**	**Bloom's level**
CO1	analysis of determinate and Indeterminate structures	Understand
CO2	Analysis of continuous beam, pin-jointed plane frames and rigid	Analysis

	frames by stiffness matrix method.	
CO3	Calculation of stresses and strains.	Apply
CO4	Comparison of Truss element and Beam element	Remember
CO5	Analyze Truss element by FEM	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	L	-	-	L	-	-	-	M	-	-
CO2	M	S	-	-	-	-	-	-	-	-	L	L
CO3	S	-	S	-	-	-	-	-	-	-	-	-
CO4	S	S	-	M	-	M	-	-	-	-	-	-
CO5	S	S	-	-	S	L	M	-	M	S	-	-

SYLLABUS:

MODULE I

FLEXIBILITY MATRIX METHOD

Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy - Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

MODULE II

STIFFNESS MATRIX METHOD

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two)

MODULE III

GENERAL

General – steps involved- Advantages and Disadvantages of the method-Applications. Basic concepts-stresses and strains- Equilibrium equations- strain –Displacement equations-compatibility equations-constitutive equations-Boundary conditions.

MODULE IV

FINITE ELEMENT METHOD

Introduction – Discretisation of a structure – Displacement functions – Truss element – Beam element – Plane stress and plane strain - Triangular elements

MODULE V

SPACE AND CABLE STRUCTURES

Analysis of Space trusses using method of tension coefficients – Beams curved in plan Suspension cables - cables with two and three hinged stiffening girders.

LEARNING RESOURCES:

Text Books:

1. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, “Theory of Structures”, Laxmi Publications, 2004.
2. Vaidyanathan, R. and Perumal, P., “Comprehensive structural Analysis – Vol. I & II”, Laxmi Publications, New Delhi, 2003
3. Negi L.S. &Jangid R.S., “Structural Analysis”, Tata McGraw Hill Publications, New Delhi, 2003.
4. BhavaiKatti, S.S, “Structural Analysis – Vol. 1 Vol. 2”, Vikas Publishing House Pvt. Ltd., New Delhi, 2008

References:

1. Ghali.A, Nebille,A.M. and Brown,T.G. “Structural Analysis” A unified classical and Matrix approach” 6th edition. Spon Press, London and New York, 2013.
2. Coates R.C, Coutie M.G. and Kong F.K., “Structural Analysis”, ELBS and Nelson, 1990
3. Pandit G.S. & Gupta S.P. "Structural Analysis – A Matrix Approach", Tata McGraw Hill 2004.
4. William Weaver Jr. & James M. Gere, "Matrix Analysis of Framed Structures", CBS Publishers and Distributors, Delhi, 2004

Course Code:	TANSPORTATION ENGINEERING LAB	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		0	0	3	2	SEE Marks **60**

COURSE OBJECTIVES:

- To learn the principles and procedures of testing of highway materials

COURSE OUTCOMES:

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

- Student knows the techniques to characterize various pavement materials
- Understand the various shapes of aggregates, strength of aggregates.
- To have knowledge in various soil, aggregate, bitumen test.

SYLLABUS:

LIST OF THE EXPERIMENTS:

1. Specific Gravity of aggregate
2. Los Angeles Abrasion Test
3. Water Absorption of Aggregates
4. Impact test
5. Shape test
6. CBR test
7. Crushing value test
8. Specific Gravity of Bitumen
9. Penetration Test
10. Viscosity Test
11. Softening Point Test
12. Ductility Test
13. Flash and fire point test
14. Marshall Stability test

LEARNING RESOURCES:

1. . Khanna S. K., Justo C.E.G, & Veeraragavan A., “Highway Materials and Pavement Testing”, Nem Chand and Bros., Roorkee- 247 667.

2. Gambhir, M.L., Jamwal, Neha," Lab Manual: Building and Construction Materials, Testing and Quality Control" McGraw Hill Education (India), Pvt.Ltd., Noida.
3. Duggal, Ajay K., Puri, Vijay P.," Laboratory Manual in Highway Engineering" New Age International (P) Limited, Publishers, New Delhi.
4. Sood Hemant, Mittal, L.N., Kulkarni,P.D., " Laboratory Manual on Concrete Technology" CBS Publishers & Distribiters Pvt. Ltd. New Delhi

FOURTH SEMESTER

Course Code:	DESIGN OF CONCRETE STRUCTURES - I	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		2	1	0	3	SEE Marks **60**

COURSE OBJECTIVES:

This Course will enable students to

- To provide basic knowledge of mathematics, science and engineering in the areas of limit state of collapse and serviceability of R C elements.
- Enable the students to identify, formulate and solve engineering problems of R C elements subjected to flexure, shear and torsion.
- To give procedural knowledge to design R C elements such as beams, slabs, columns, footing and stairs subjected to various load combinations and boundary conditions as per specification and needs.
- To develop the culture of professional and ethical responsibilities by following codal provisions in the analysis, design and detailing of R C elements for strength and durability

COURSE OUTCOMES:

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

- Explain the various design concepts and design a beam under flexure and draw the reinforcement details.
- Design the T-beam, Design a RC slab and staircase and draw the reinforcement details.
- Design the beam under shear and torsion, Calculate the anchorage and development length and check the serviceability requirements for RC structural elements. Design a RC slab and staircase and draw the reinforcement details.
- Design a short columns and long columns and draw the reinforcement details
- Design a retaining wall, and strip, isolated and combined footings water tank and draw the reinforcement details.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Understand the design concepts and design a beam under flexure and draw the reinforcement details.	Understand
CO2	Design the T-beam, Design a RC slab and staircase and draw the reinforcement details.	Understand, Apply
CO3	Calculate the anchorage and development length and check the serviceability requirements for RC structural elements	Apply
CO4	Design a short columns and long columns and draw the reinforcement details	Understand, Apply

CO5	Design a retaining wall, and strip, isolated and combined footings water tank and draw the reinforcement details	Understand

Mapping of Course Outcome to Program Outcomes

Mapping of COs with POs												
Course Outcomes (Cos)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	M	S	M	S	M	M	M	S	M
CO2	S	S	S	M	M	L	M	L	-	S	S	L
CO3	S	S	S	M	-	M	-	M	S	S	-	S
CO4	S	M	-	L	-	-	-	S	-	S	S	S
CO5	S	S	L	S	M	S	S	M	S	M	-	L

SYLLABUS:

MODULE I

DESIGN CONCEPTS AND WORKING STRESS DESIGN OF BEAMS FOR FLEXURE

Design concepts - Concept of elastic method, ultimate load method and limit state method– Advantages and disadvantages of working stress method over other methods –Design of rectangular beam section by working stress method – Working stress method of design of singly reinforced, doubly reinforced and flanged beams.

MODULE II

WORKING STRESS DESIGN OF T BEAM, SLAB AND STAIRCASE

Working stress design of T- beam and L Beam for bending moment – Classification of slab - Behaviour of one way and two way slabs - Design of one way simply supported square slab, rectangular slab and Continuous slabs, Flat slab - Design of two-way slabs for various edge conditions - Torsion reinforcement at corners- Types of staircases - Design of dog-legged staircase.

MODULE III

WORKING STRESS DESIGN OF COMPRESSION MEMBER

Columns-Assumptions –Effective length –classification –Design guidelines-Axially loaded short column with lateral ties and helical reinforcement-Axially loaded short column subjected to uniaxial and biaxial bending - Axially loaded long column subjected to biaxial bending.

MODULE IV

LIMIT STATE DESIGN OF BEAM FOR FLEXURE AND SHEAR, FLAT SLABS

Limit state design of RC beams for shear and torsion - Design of RC beams for combined bending, shear and torsion – Use of design aids - Design requirement for bond and anchorage as per IS code – Detailing of reinforcement – Concept of Serviceability - Serviceability requirements for deflection.- Design of flat slabs

MODULE V

LIMIT STATE DESIGN OF FOOTING

Foundation – Classification – Design guidelines - Design of footing for masonry and reinforced walls – Design of axially and eccentrically loaded square and rectangular footings – Design of combined rectangular footings for two columns. Design of Raft foundation.

LEARNING RESOURCES:

Text Books:

1. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (Third Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition,2017.
2. Ramamrutham, Reinforced concrete structure, Dhanpat Rai& sons, New delhi, 2015
3. B.C. Punmia. Ashok K. Jain and Arun K. Jain, Limit State design of Reinforced Concrete, Laxmi Publications (P) Ltd., New Delhi,2016.
4. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2012.

References:

1. Park R, Paulay T, Reinforced Concrete Structures,John Wiley& sons, Newyork, 2000
2. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.
3. P.C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt. Ltd., New Delhi, Second Edition,2008.
4. S.N. Sinha, Reinforced Concrete Design, Tata McGraw-Hill, New Delhi,2002

IS CODES

1. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2. IS 875(1-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
3. SP 16:1980 Design Aids for Reinforced Concrete to IS456:1978.
4. SP 34:1987 Handbook of concrete reinforcement and detailing.
5. National Building Code of India 2016 (NBC2016)

Course Code:	DESIGN OF STEEL STRUCTURES	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

- Learn the basic elements of a steel structure
- Learn the fundamentals of structural steel fasteners
- Able to design basic elements of steel structure like tension members, compression members, beams and beam-columns
- Able to design column splices and bases.

COS NO.	Course Outcomes	Bloom's level
CO1	Recognize the design philosophy of steel structures and identify the different failure modes of bolted and welded connections, and determine their design strengths.	Understand
CO2	Select the most suitable section shape and size for tension and compression members and beams according to specific design criteria	Analysis
CO3	Apply the principles, procedures and current code requirements to the analysis and design of steel tension members, columns, column bases and beams	Apply
CO4	Identify and compute the design loads on Industrial structures, and gantry girder	Remember
CO5	Find out ultimate load of steel beams and portal frames using plastic analysis	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	-	-	-	-	-	-	M	-	M
CO2	M	M	L	-	M	-	-	-	-	-	M	M
CO3	M	M	M	-	M	-	-	-	-	-	M	M

CO4	M	M	M	-	M	M	-	M	M	M	M	M
CO5	M	M	M	M	-	-	L	-	-	-	-	M

SYLLABUS:

MODULE I
INTRODUCTION TO STRUCTURAL STEEL AND DESIGNOFCONNECTIONS:

General -Types of Steel -Properties of structural steel - I.S. rolled sections - Concept of Limit State Design - Design of Simple and eccentric Bolted and welded connections - Types of failure and efficiency of joint – prying action - Introduction to HSFG bolts

MODULE II
TENSION AND COMPRESSIONMEMBERS:

Behaviour and Design of simple and built-up members subjected to tension - Design of lug angles - tension splice - Behaviour of short and long columns - Euler's column theory-Design of simple and built-up compression members with lacings and battens - Design of column bases - slab base and gusseted base.

MODULE III
FLEXURE MEMBER AND SPACE TRUSS:

Design of laterally supported and unsupported beams - Design of built-up beams - Design of plate girders-Application of space truss-Advantages and Disadvantages of space truss-Design of Space truss structure.

MODULE IV
INDUSTRIAL STRUCTURES:

Design of roof trusses – loads on trusses – purlin design using angle, channel sections and tube sections of circular and rectangular – truss design, Design of joints and end bearings–Design of gantry girder - Introduction to pre-engineered buildings.

MODULE V
PLASTIC ANALYSISAND DESIGN:

Introduction to plastic analysis - Theorems of plastic Analysis - Design of continuous beams and portal frames using plastic design approach. Introduction to steel bridge loading *pattern.*

LEARNING RESOURCES:

Text Books:

1. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010
2. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.
3. Ramamrutham.S, Design of Steel structures, Dhanpatrai Publications, Newdelhi.

References:

1. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited,2013
2. Jack C. McCormac and Stephen F Csernak, Structural Steel Design, Pearson Education Limited, 2013.
3. Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers,2014
4. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi,2016
5. Ramamrutham.S "Steel Tables" Dhanpatrai Publishing Company, Newdelhi

IS CODE

IS: 800-1984	Code for practice for general construction in steel.
IS: 806 -1968 (1st Rev)	Code of Practice for use of steel tubes in general building construction.
IS: 808 -1989 (3rd Rev)	Dimension for hot rolled steel beam, channel and angle sections.

Course Code:	**STADD PRO LAB**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		0	0	3	2	SEE Marks **60**

COURSE OBJECTIVES:

- This course trains the students to carry out basic build frame analysis and design for concrete and steel structures.

COURSE OUTCOMES:

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

- After the laboratory learning the students understand the Modelling, analysis and design using STAAD Pro.

SYLLABUS:

LIST OF THE EXPERIMENTS:

1. Introduction to STADD PRO
2. Analysis and design of Simply Supported Beam using STADD PRO Software.
3. Analysis and design of Overhanging Beam using STADD PRO Software
4. Analysis and design of continuous Beam using STADD PRO Software
5. Analysis and design of Symmetrical Building Frames (Gravity Load Only) using STADD PRO Software.

6. Analysis and design of Symmetrical Building Frames (Wind Load Only) using STADD PRO Software.
7. Analysis and design of Symmetrical Building Frames(Earthquake Load Only) using STADD PRO Software.
8. Analysis and design of Multi story Building Frames (All load combination) using STADD PRO Software
9. Analysis and design of trust member using STADD PRO Software.
10. Analysis and design of foundation Using STADD PRO Software.
11. Analysis and design of Rectangular water tank using STADD PRO Software.

LEARNING RESOURCES:

1. STADD PRO Software Working Manuals.
2. Krishnaraju.N, *Advanced R.C.Design*, CBS Publishers & Distributors Pvt. Ltd, New Delhi, 2012.
3. Punmia.B.C, et al, *R.C. Structures- Vol.I& II,* Laxmi Publications, Chennai, (P) Ltd., 1995
4. Mallick.S.K&Gupta.A.P, *Reinforced Concrete*, Oxford I B H, New Delhi, 1987.
5. Park and Paulay. T, *R.C. Structures*, Tata McGraw Hill Publications, New Delhi, 1975.

FIFTH SEMESTER

Course Code:	ENVIRONMENTAL ENGINEERING - I	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To identify and understand the sources of water, characteristics and its demand in various fields.
- To know how to collect and convey the water to various points.
- To equip the students with the principles and design of water treatment units and distribution system

COURSE OUTCOMES:

- Impart Knowledge on the structure of drinking water supply systems, including water transport, treatment and distribution
- Understand the water quality criteria and standards, and their relation to public health
- Impart knowledge in various unit operations and processes in water treatment
- Design the various functional units in water treatment
- Analyze the distribution network for pipe loops.

After learning the course the students should be able to:

COS NO.	Course Outcomes	Bloom's level
CO1	Impart Knowledge on the structure of drinking water supply systems, including water transport, treatment and distribution	Remember
CO2	Understand the water quality criteria and standards, and their relation to public health	Understand
CO3	Impart knowledge in various unit operations and processes in water treatment	Apply
CO4	Design the various functional units in water treatment	Analysis
CO5	Analyze the distribution network for pipe loops.	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	L	L	M	-	-	L	-	-	M	-	L
CO2	M	S	M	-	-	-	-	-	-	L	-	L
CO3	M	M	S	-	-	-	L	-	-	L	L	M
CO4	M	M	S	-	L	-	L	-	-	L	-	M

CO5	S	M	M	M	L	-	L	-	-	L	-	L

SYLLABUS:

MODULE I
SOURCES OF WATER

Public water supply system – Need for planned water supply schemes, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards, water quality indices.

MODULE II
TRANSMISSION OF WATER

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

MODULE III
WATER TREATMENT

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, Flash mixer, Coagulation and flocculation – Sedimentation- Plate and tube settlers - sand filters - Disinfection – aeration, Residue Management –Construction, Operation and Maintenance aspects.

MODULE IV
ADVANCED WATER TREATMENT

Water softening -demineralization – A Desalination- R.O. Plant adsorption - Ion exchange– Membrane Systems – RO Reject Management - Iron and Manganese Removal, Fluoridation and De Fluoridation, Construction Operation and Maintenance aspects – Recent advances - MBR process

MODULE V
WATER DISTRIBUTION AND SUPPLY

Water distribution – Requirements, types and methods. Components – Selection of pipe material – Service reservoirs – Functions –design - Analysis of distribution networks - Computer applications – Appurtenances – Leak detection. Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing

LEARNING RESOURCES:
Text Books:

1. Garg, S.K. Environmental Engineering, Vol.IKhanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.
3. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2014.
1. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
2. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw–Hill International Editions, New York 1985.

References:

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

2. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Designand Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.

3. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.

Course Code:	**REMOTE SENSING AND GIS**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: **PCC**		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To make the students understand the concepts, components and source of remote sensing
- To gain knowledge about different types of remote sensing platforms andsensors
- To explain the concept of satellite imageinterpretation
- To understand the applications of remote sensing in CivilEngineering
- To introduce the fundamentals and components of Geographic InformationSystem
- To provide details of spatial data structures and management, input and outputprocesses.
- To explain the various case studies on application of integration of GIS and Remote Sensing.

COURSE OUTCOMES:

- Impart Knowledge on the concepts, platforms and laws related to remote sensing
- Understand the interaction of electromagnetic radiation with atmosphere and earth material
- Acquire knowledge about satellite orbits, different types of satellites and the different types of remote sensors
- Understand the fundementals of GIS, maps, data structures and analysis of data
- Gain knowledge about the concepts of interpretation of satellite imagery and civil engineering applications

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

COS NO.	Course Outcomes	Bloom's level
CO1	Understand the concepts, platforms and laws related to remote sensing	Understand
CO2	Understand the interaction of electromagnetic radiation with atmosphere and earth material	Understand
CO3	Acquire knowledge about satellite orbits, different types of satellites and the different types of remote sensors	Remember
CO4	Understand the fundementals of GIS, maps, data structures and analysis of data	Analysis
CO5	Gain knowledge about the concepts of interpretation of satellite imagery and civil engineering applications	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	-	-	-	S	M	-	-	-	L	-	M
CO2	S	M	-	M	S	M	-	-	-	M	-	M
CO3	S	M	M	M	S	M	-	-	-	M	-	M
CO4	S	M	M	L	M	M	-	-	-	L	-	L
CO5	S	M	M	M	L	M	L	-	-	L	-	L

SYLLABUS:

MODULE I

REMOTE SENSING

Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body - Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infra Red (IR), Near IR, Middle IR , Thermal IR and Microwave – Black Body Radiation - Planck's law – Stefan-Boltzman law.

MODULE II

EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIALS

Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non-selective and Raman Scattering – EMR Interaction with Water vapour and ozone – Atmospheric Windows – Significance of Atmospheric windows – EMR interaction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and Transmitted Energy – Reflectance – Specular and Diffuse Reflection Surfaces- Spectral Signature – Spectral Signature curves – EMR interaction with water, soil and Earth Surface.

MODULE III

OPTICAL AND MICROWAVE REMOTE SENSING

Satellites - Classification – Based on Orbits – Sun Synchronous and Geo Synchronous – Based on Purpose – Earth Resources Satellites, Communication Satellites, Weather Satellites, Spy Satellites – Satellite Sensors - Resolution – Spectral, Spatial, Radiometric and Temporal Resolution – Description of Multi Spectral Scanning – Along and Across Track Scanners – Description of Sensors in Landsat, SPOT, IRS series – Current Satellites - Radar – Speckle - Back Scattering – Side Looking Airborne Radar – Synthetic Aperture Radar – Radiometer – Geometrical characteristics.

MODULE IV

GEOGRAPHIC INFORMATION SYSTEM

GIS – Components of GIS – Hardware, Software and Organisational Context – Data – Spatial and Non-Spatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters.

MODULE V

MISCELLANEOUS TOPICS

Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Image – Image enhancement – Filtering – Classification - Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Urban Applications - Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems.

LEARNING RESOURCES:

Text Books:

1. Anji Reddy, Remote Sensing and Geographical Information Systems , BS Publications 2001

2. M.G. Srinivas(Edited by), Remote Sensing Applications, Narosa Publishing House, 2001.

References:

1. Lillesand T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.

2. Janza.F.J., Blue, H.M., and Johnston, J.E., "Manual of Remote Sensing Vol.I., American Society of Photogrammetry, Virginia, U.S.A, 1975.

3. Burrough P A, Principle of GIS for land resource assessment, Oxford, 1990

Course Code:	**REMOTE SENSING AND GIS LAB**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		0	0	3	2	SEE Marks **60**

COURSE OBJECTIVES:

- To make the students understand the concepts of spatial technologies
- To gain knowledge about different types of data utilization
- To explain the concept of map preparation
- To understand the applications of remote sensing and Geographic Information System (GIS) in CivilEngineering
- To explain the spatial analysis and identifying the solution through GIS
- To gain knowledge in Global positioning System (GPS)

COURSE OUTCOMES:

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

- The students can understand the basic concepts of spatial technologies and able to do analysis of the various spatial data and non-spatial data in GIS platform.

SYLLABUS:

LIST OF THE EXPERIMENTS:

1. Introduction to Georeferencing
2. Digitization
3. Creation, digitization and analysis of point feature.
4. Creation, digitization and analysis of Line feature.
5. Creation, digitization and analysis of Polygon feature.
6. Digitization of SCSVMV campus
7. Proximity Analysis for point feature
8. Proximity Analysis for Line feature
9. Creation of Digital Elevation Model (DEM)
10. Network analysis data set creation and analysis
11. Introduction to Global Positioning System (GPS)
12. Data collection by using GPS
13. GPS data retrieval, analysis and exporting.

LEARNING RESOURCES:

1. Anji Reddy, Remote Sensing and Geographical Information Systems , BS Publications 2001
2. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
3. DeMers, M.N., Fundamentals of Geographic Information Systems, John Wiley & Sons, New York, 2000.
4. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992

Course Code:	REMOTE SENSING AND GIS LAB	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		0	0	3	2	SEE Marks **60**

COURSE OBJECTIVES:

- To make the students understand the concepts of spatial technologies
- To gain knowledge about different types of data utilization
- To explain the concept of map preparation
- To understand the applications of remote sensing and Geographic Information System (GIS) in CivilEngineering
- To explain the spatial analysis and identifying the solution through GIS
- To gain knowledge in Global positioning System (GPS)

COURSE OUTCOMES:

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

- The students can understand the basic concepts of spatial technologies and able to do analysis of the various spatial data and non-spatial data in GIS platform.

SYLLABUS:

LIST OF THE EXPERIMENTS:

14. Introduction to Georeferencing
15. Digitization
16. Creation, digitization and analysis of point feature.
17. Creation, digitization and analysis of Line feature.
18. Creation, digitization and analysis of Polygon feature.
19. Digitization of SCSVMV campus
20. Proximity Analysis for point feature
21. Proximity Analysis for Line feature
22. Creation of Digital Elevation Model (DEM)
23. Network analysis data set creation and analysis
24. Introduction to Global Positioning System (GPS)
25. Data collection by using GPS
26. GPS data retrieval, analysis and exporting.

LEARNING RESOURCES:

5. Anji Reddy, Remote Sensing and Geographical Information Systems , BS Publications 2001
6. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
7. DeMers, M.N., Fundamentals of Geographic Information Systems, John Wiley & Sons, New York, 2000.
8. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992

SIXTH SEMSTER

Course Code:	DESIGN OF CONCRETE STRUCTURES-II	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Understand the concepts of advanced structural design of building frames.
- Understand the concepts of water tanks, Design of slab culverts, Design of stair cases.
- To design the prestressed concrete members and design of retaining wall.
- To enhance the structural design skill to develop confidence in structural design.

COURSE OUTCOMES:

- The students will have the knowledge of analysis and design of multi-storeyed frames with lateral loads.
- The students will have the knowledge of analysis and design of the water tanks of different sizes for various staging conditions.
- The students will have the knowledge of Introduction of bridge engineering, design of slab, masonry wall and stair cases.
- The students will have the knowledge of Introduction of prestressed concrete.
- The students will have the knowledge of analysis and design of the retaining walls of different types.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Analysis and design of multi-storeyed frames with lateral loads.	Analysis
CO2	Analysis and design of the water tanks of different sizes for various staging conditions.	Analysis
CO3	Introduction of bridge engineering,	Understand
CO4	Design of slab, masonry wall and stair cases.	Analysis
CO5	Introduction of prestressed concrete.	Remember
CO6	Design of end blocks.	Analysis
CO7	Analysis and design of the retaining walls of different types.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	S	S	S	M	M	L	M	M	M	L
CO2	M	M	S	S	S	S	L	L	S	S	L	M
CO3	S	S	S	S	M	M	L	L	M	S	L	L
CO4	M	M	S	S	S	M	M	L	S	M	M	M
CO5	S	S	S	S	M	M	M	L	S	S	M	M
CO6	M	M	S	S	M	S	S	L	S	S	M	M
CO7	M	M	S	S	M	S	S	M	M	M	L	M

SYLLABUS:

MODULE I

DESIGN OF CONCRETE FRAMES

Analysis and design of concrete Building frames: load combinations for gravity and lateral loads (wind or seismic)- Substitute frame method for gravity loads - Portal and Cantilever methods for lateral loads - Analysis and design of two storied two bay concrete Plane frames under gravity and lateral loads- Reinforcement detailing as per SP 34 : 1987 and IS 13920: 1993.

MODULE II

DESIGN OF WATER TANKS

Classification of water tanks- Design guidelines-joints in water tank- Design of square, and circular shape water tanks resting on ground as per IS code method(IS 3370 (Part IV): 1967) - Design of Rectangular, and square shape underground water tanks– Detailing of Reinforcement as per SP 34: 1987.

MODULE III

DESIGN OF BRICK MASONRY WALL AND DOMES

Introduction to bridge engineering, Investigation for bridges, IRC loadings, Design of slab culvert; Design of Brick Masonry walls -Design of spherical Domes - Reinforcement Detailing as Per SP:34 -1987.

MODULE IV

INTRODUCTION TO PRESTRESSED CONCRETE

Introduction of prestressed concrete – Concept of prestressing - Basic principles of prestressing – Classification and types – Materials used in prestressed concrete – Advantages and disadvantages of prestressed concrete – prestressing methods – methods of internal prestressing – prestressing systems – Losses of prestress- pre-tensioned members – Design of end blocks.

MODULE V

DESIGN OF RETAINING WALLS

Design of cantilever type retaining walls with surcharge and traffic loads - Design of cantilever type retaining walls without surcharge - Design of counter-fort type retaining walls with surcharge and traffic loads - Reinforcement detailing as per SP 34: 1987.

LEARNING RESOURCES:

Text Books:

1. Krishnaraju. N, "Advanced R.C Design", CBS Publishers & Distributors Pvt Ltd, New Delhi 2012.
2. .Punmia.B.C, "*R.C.Structures - Vol.I &II",* Laxmi Publications (P) LTD, New Delhi 1995

References:

1. Ramamrutham.S and Narayan.R, "*Design of R.C. Structures",* Dhanpat Rai and Sons, Delhi, 1992
2. Dayaratnam P, "*Design of RC Structures"*, OXFORD & IBH Publishing Co, New Delhi, 2000.
3. Punmia.B.C, "*R.C.Structures – Vol. II"*, Standard Publishers, New Delhi, 1991.
4. Mallick.S.K & Gupta.A.P, "*Reinforced Concrete"*, Oxford I B H, New Delhi, 1987.
5. Park and Paulay. T, "*R.C.Structures"*, Tata McGraw Hill Publications, New Delhi, 1975.

Course Code:	**ENVIRONMENTAL ENGINEERING - II**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		2	0	2	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand about physical, chemical, and biological phenomena.
- To understand about design, operation and maintenance of sewage treatment plants.
- To understand about primary, secondary treatment of sewage
- To understand about disposal of sewage
- To understand about sludge treatment and disposal

COURSE OUTCOMES:

- An ability to estimate sewage generation and design sewer system including sewage pumping stations
- Understand the characteristics and composition of sewage,
- An ability to perform basic design of the unit operations and processes that are used in sewage treatment
- Understand the standard methods for disposal of sewage and self-purification of streams
- Gain knowledge on sludge treatment and disposal.

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

COS NO.	Course Outcomes	Bloom's level
CO1	An ability to estimate sewage generation and design sewer system including sewage pumping stations	Analysis
CO2	Understand the characteristics and composition of sewage	Understand
CO3	An ability to perform basic design of the unit operations and processes that are used in sewage treatment	Apply
CO4	Understand the standard methods for disposal of sewage and self-purification of streams	Remember
CO5	Gain knowledge on sludge treatment and disposal.	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	-	-	L	-	-	M	-	L
CO2	M	L	S	L	-	-	L	-	-	L	-	L
CO3	M	L	S	L	-	-	L	-	-	L	L	M
CO4	L	L	L	-	L	-	L	L	-	S	-	L
CO5	L	L	M	M	L	-	M	L	-	S	-	L

SYLLABUS:

MODULE I

PLANNING AND DESIGN OF SEWERAGE SYSTEM

Sources of waste water-Characteristics and composition of sewage - population equivalent -Sanitary sewage flow estimation – Storm drainage-Storm runoff estimation- Sewer materials – Hydraulics of flow in sanitary sewers – Sewer design –– sewer appurtenances – corrosion in sewers – prevention and control – sewage pumping-drainage in buildings-plumbing systems for drainage - Rain Water harvesting

MODULE II

PRIMARY TREATMENT OF SEWAGE

Objectives – Unit Operations and Processes – Selection of treatment processes –- Onsite sanitation - Septic tank- Grey water harvesting – Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks – Construction, Operation and Maintenance aspects.

MODULE III

SECONDARY TREATMENT OF SEWAGE

Objectives – Selection of Treatment Methods – Principles, Functions, - Activated Sludge Process and Extended aeration systems -Trickling filters– Sequencing Batch Reactor(SBR) – Membrane Bioreactor - UASB – Waste Stabilization Ponds – - Other treatment methods -Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction, Operation and Maintenance aspects.

MODULE IV

DISPOSAL OF SEWAGE

Standards for– Disposal - Methods – dilution – Mass balance principle - Self purification of river- Oxygen sag curve – de oxygenation and re aeration - Streeter–Phelps model - Land disposal – Sewage farming – sodium hazards - Soil dispersion system.

MODULE V

SLUDGE TREATMENT AND DISPOSAL

Objectives - Sludge characterization – Thickening - Design of gravity thickener- Sludge digestion – digester design- Biogas recovery – Sludge Conditioning and Dewatering – Sludge drying beds- ultimate residue disposal – recent advances

LEARNING RESOURCES:

Text Books:

1. Garg, S.K. Environmental Engineering, Vol.II Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Waste Water Engineering, Vol.II Standard Book House, New Delhi, 2010.
3. Punmia, B.C.,Ashok Jain and Arun Jain, Waste Water Engineering, Laxmi Publications (P) Ltd., New Delhi, 2014.
4. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi. 2010
5. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985.

References:

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry
2. of Urban Development, Government of India, New Delhi, 2013.
3. Syed R. Qasim “Wastewater Treatment Plants”, CRC Press, Washington D.C.,2010
4. Gray N.F, “Water Technology”, Elsevier India Pvt. Ltd., New Delhi, 2006

Course Code:	ESTIMATION ANDQUANTITYSURVEYING	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		2	1	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- This subject covers the various aspects of estimating of quantities of items of works involved in buildings, water supply and sanitary works, road works and irrigation works.
- This also covers the rate analysis, valuation of properties and preparation of reports for estimation of various items.
- Student should also be able to prepare value estimates.
- To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, valuation of properties and preparation of reports for estimation of various items.

COURSE OUTCOMES:

- Explain the types of estimates and method of estimates.
- Estimate quantities of items of works for residential buildings with similar foundations for walls Individual wall method.
- Estimate quantities of items of works for other than building structures.
- Conduct rate analysis for different types of works.
- Valuation and Preparation of reports on residential building and other structures

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

COS NO.	Course Outcomes	Bloom's level
CO1	Types of estimates and method of estimatesMake specifications and prepare tender documents.	Understand
CO2	Estimate the material quantities, prepare a bill of quantities, Prepare value estimates.	Analysis
CO3	Estimate quantities of items of works for different types of structures	Analysis
CO4	Rate analysis for different types of works	Analysis
CO5	Preparea reports on residential building and other structures	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	S	S	L	-	M	L	M	S	-	M	-
CO2	S	M	S	M	M	-	-	-	M	L	M	L
CO3	S	M	M	S	S	L	L	-	S	L	M	L
CO4	S	-	-	S	M	-	L	-	S	M	L	M
CO5	S	M	S	S	-	L	M	S	S	-	M	-

SYLLABUS:

MODULE I

ESTIMATEOFBUILDINGS

Introduction to estimation- Necessity of Estimation-Types of Estimates- Methods of Estimation-Load bearing and framed structures.

Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof – Various types of arches – Calculation of brick work and RCC works in arches – Estimate of joineries for panelled and glazed doors, windows, ventilators, handrails etc.- Estimation of Steel for RCC works.

MODULE II

ESTIMATE OFOTHERSTRUCTURES

Estimating of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well.

Estimate of bituminous and cement concrete roads – estimate of retaining walls – culverts – estimating of irrigation works – aqueduct, syphon, and fall.

MODULE III

SPECIFICATION ANDTENDERS

Data – Schedule of rates – Analysis of rates – Specifications – sources – Detailed and general specifications

Tenders – Contracts – Types of contracts, BOT – Arbitration and legal requirements.

MODULE IV

VALUATION

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease

MODULE V

REPORTPREPARATION

Principles for report preparation – report on estimate of Official building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

LEARNING RESOURCES:

Text Books:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd.,2003
2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand& Company Ltd.,2004.

References:

1. PWD Data Book
2. CPWD Schedule of rates

Course Code:	**REVIT ARCHITECTURE LAB**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: ESC		0	0	3	2	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce the students to basic concepts of the BIM application process can be used during design and architecture process creating a clear picture used for better and more integrated designs.

COURSE OUTCOMES

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

- To draw the setting up levels and grids in building using Revit software.
- To draw a different types of modeling walls in building using Revit software
- To draw the doors and windows in building using Revit software
- To draw a curtain walls in building using Revit software
- To draw different types of view and floor in a building using Revit software
- To draw a framed structures in a building using Revit software
- To draw 3D drawing of the Building

- To develop the BIM model of a simple building
- To taking qunatities from Revit drawing
- Converting Revit drawing into Autocad drawing

SYLLABUS:

LIST OF THE EXPERIMENTS:

1. Introduction to BIM & AUTODESK REVIT
2. Basic Drawing and editing tools
3. Setting Up Levels And Grids
4. Modeling Walls
5. Working With Doors And Windows
6. Working With Curtain Walls
7. Working With Views
8. Adding Components
9. Modeling Floors
10. Modeling Ceilings & Roofs
11. Modeling Stairs And Railing
12. Structural Modelling (Framed Structure- foundation to roof slab)
13. 3D modelling of the building
14. BIm modelling for a simple building
15. Extracting quantities from Revit drawing
16. Converting the Revit drawing into Autocad drawing

LEARNING RESOURCES:

1. Lernout & Hauspie, “Revit Architecture”, Spatial Corp auto desk Company Ltd, U.S 2008.
2. http://www.ictacademy.in/pages/Building-Information-Modeling-using-Autodesk-Revit.aspx#

Online resources:

1. https://academy.autodesk.com/curriculum/introduction-bim
2. https://www.youtube.com/watch?v=fiUr9B2yKiI
3. https://www.youtube.com/watch?v=waWSAsjdDEg
4. https://www.youtube.com/watch?v=9asz0tQbRnY

SEVENTH SMESTER

Course Code:	CONSTRUCTION ENGINEERING & MANAGEMENT	L	T	P	Credit	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand about construction project planning, estimating activity, duration.
- To understand about preparation of networks.
- To understand about planning and organizing construction site and resources.
- To understand about record keeping, safety, health and environment on project sites.
- To understand about various construction equipment.

COURSE OUTCOMES:

- An idea of how structures are built and projects are developed on the field.
- A basic ability to plan, control and monitor construction projects with respect to time.
- An idea of planning and organizing construction site and resources.
- An ability to put forward ideas and understandings to others with effective communication processes.
- An understanding of modern construction equipment and practices

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

COS NO.	Course Outcomes	Bloom's level
CO1	An idea of how structures are built and projects are developed on the field.	Understand
CO2	A basic ability to plan, control and monitor construction projects with respect to time.	Analysis
CO3	An idea of planning and organizing construction site and resources.	Apply
CO4	An ability to put forward ideas and understandings to others with effective communication processes	Remember
CO5	An understanding of modern construction equipment and practices	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	---	---	L	S	M	L	L	M	S	S
CO2	M	M	M	L	L	M	M	M	L	M	S	M
CO3	L	L	L	M	---	L	L	L	M	M	S	S
CO4	L	---	---	L	---	S	S	M	L	M	S	M
CO5	L	---	L	L	---	M	M	L	L	L	M	M

SYLLABUS:

MODULE I

CONSTRUCTION PROJECT PLANNING

Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data.

MODULE II

NETWORK TECHNIQUES

Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations.

MODULE III

PLANNING AND ORGANIZING

Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource aggregation, allocation, smoothening and leveling.

MODULE IV

RECORD KEEPING AND SAFETY

Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

MODULE V

CONSTRUCTION EQUIPMENT

Construction Equipment basics*:* Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

LEARNING RESOURCES:

Text Books:

5. Varghese, P.C., "*Building Construction"*, Prentice Hall India, 2007.
6. *National Building Code,* Bureau of Indian Standards, New Delhi, 2017.
7. Chudley, R., *Construction Technology*, ELBS Publishers, 2007.
8. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011

References:

1. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
2. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
3. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

ELECTIVE SUBJECTS

PROFESSIONAL ELECTIVE COURSE – I

(Geotechnical Engineering)

A. Foundation Engineering

B. Geotechnical Design

C. Offshore Engineering

D. Rock Mechanics

E. Environmental Geo-technology

F. Ground improvement techniques

PROFESSIONAL ELECTIVE COURSES

PEC - I Geotechnical Engineering

Course Code:	FOUNDATION ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To emphasize the importance of soil investigations including destructive and non-destructive methods
- To explain how earth pressure theory is important in retaining structure design.
- To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration.
- To explain how do select a suitable shallow foundation system for various site conditions and also analysis of different foundation system.
- To explain in what circumstances pile is needed and how do analysis the pile and pile group under various soil conditions.

COURSE OUTCOMES:

- Analyse earth retaining structures for any kind of soil medium.
- Carry out soil investigation for any civil engineering construction
- Estimate bearing capacity using IS code methods.
- Design proper foundations for any kind of shallow foundation system.
- Estimate pile and pile group capacity for any kind of soil including group efficiency and negative friction

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

COS NO.	Course Outcomes	Bloom's level
CO1	Enumerate methods of sub-surface exploration and site investigation	Apply
CO2	Compute the load carrying capacity of foundations	Apply
CO3	Suggest and design appropriate shallow foundation	Apply
CO4	Determine the load carrying capacity of pile foundations and pile groups	Apply
CO5	Enumerate the various Ground Improvement Techniques	Understand
CO6	Calculate the lateral earth pressure also check the stability of retaining walls.	Apply

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	-	-	-	-	-	L	L	M
CO2	S	M	S	L	-	-	-	-	-	M	M	M
CO3	M	M	M	L	-	-	-	L	-	S	M	M
CO4	M	L	M	L	-	S	-	L	S	M	L	M
CO5	-	-	M	-	-	-	L	-	-	S	M	M
CO6	M	M	M	L	-	-	-	-	-	M	M	M

SYLLABUS:

MODULE I

SITE INVESTIGATION AND SELECTION OF FOUNDATION

Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples –Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters - Bore log report and Selection of foundation.

MODULE II

SHALLOW FOUNDATION

Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement offoundations on granular and clay deposits – Total and differential settlement –Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.

MODULE III

FOOTINGS AND RAFTS

Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum thickness for rigid behaviour –Applications – Compensated foundation – Codal provision.

MODULE IV

PILE FOUNDATION

Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula –Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT and SCPT) – Negative skin friction – Uplift capacity-Group capacity by different methods (Feld's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift –Cohesive – expansive – non expansive – Cohesionless soils – Codal provisions.

MODULE V

RETAINING WALLS

Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and ohesive soil – Coulomb's wedge theory – Condition forcritical failure plane – Earth pressure on retaining walls of simple configurations – Culmann's Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provisions.

LEARNING RESOURCES:

Text Books:

1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.

References:

1. Braja M Das, "Principles of Foundation Engineering" (Eigth edition), Cengage Learning 2014.
2. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering",Tata McGraw Hill publishing company Ltd., New Delhi, 2014.

Course Code:	GEOTECHNICAL DESIGN	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To evaluate the physical and mechanical properties of sub grade, and pavement materials, and design flexible and rigid pavements subjected to wheel loads, Sub structure design,
- To design of Hydraulic Structure and retain the Earth pressure.

COURSE OUTCOMES:

- Various pavement material characterization techniques
- Design a suitable pavement for known wheel loading characteristics and sub grade soil conditions.
- Design a suitable foundation for Safe bearing capacity of different soil condition.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Design of Retaining walls and gravity walls.	Apply
CO2	Design of foundation and piles	Apply
CO3	Design a rigid pavement analysis concepts.	Apply
CO4	Design a Flexible pavement design methods for highways and airports	Apply
CO5	Describe components of dams and general features	Understand

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	M	-	-	M	-	M	-	S	L	-
CO2	S	S	M	M	-	-	-	-	-	-	M	-
CO3	S	S	S	L	-	L	-	S	-	-	M	L
CO4	S	S	-	L	-	L	-	S	-	-	L	L
CO5	S	S	M	M	M	L	L	-	S	M	M	L
CO6	M	-	L	-	-	L	-	M	M	-	L	M

SYLLABUS:

MODULE I

INTRODUCTION

Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements, field CBR, field plate load test, modulus of sub grade reaction, Resilient modulus, Suitability of soil, Compaction equipment and Compaction Control and Design of Retaining walls**:** Stability Analysis and design of gravity, Cantilever retaining walls.

MODULE II

FOUNDATIONS

Basic requirements of foundation –Types and selection of foundations. Design of reinforced concrete isolated, combined, eccentric, strip, and strap footings used for infrastructure projects, Types of rafts, Design of slab raft foundation and Design of beam and slab raft foundation used for infrastructure projects. design of piles, pile caps and pile- raft foundation

MODULE III

STRESSES IN RIGID PAVEMENTS:

Types of stresses and causes; Introduction to Westergaard's equations for calculation of stresses in rigid pavement due to the influence of traffic and temperature; Considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.

MODULE IV

FLEXIBLE PAVEMENT DESIGN METHODS FOR HIGHWAYS AND AIRPORTS

Empirical, semi-empirical and theoretical approaches; Development, principle, design steps of the different pavement design methods including AASHTO, Asphalt Institute, Shell Methods. IRC method of pavement design.

MODULE V

DAMS

General features, Selection of site; Merits and demerits of the earth and rock fill dams, Classification of earth dams, Causes of failure, Safe design criteria. Instrumentation in earth dams: Pore pressure measurements, Settlement gauges, Inclinometers, Stress measurements, Seismic measurements.

LEARNING RESOURCES:

Text Books:

1. Analysis and Design of substructure: Limit state Design by Swami Saran
2. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice- Hall.
3. Tomlinson. M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 1995.

References:

1. Bharat Singh and Sharma, H. D. – Earth and Rockfill Dams, 1999
2. Pavement and Surfacing for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.
3. IS 2911: Part 1: Sec 1: 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 1 Driven cast in-situ concrete piles.

Course Code:	**OFFSHORE ENGINEERING**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand differences between the soil and loading conditions of on-shore and offshore structures, various types of offshore foundation systems
- To evaluate the performance of offshore structures.

COURSE OUTCOMES:

- Design and evaluate the performance of offshore foundations.
- The design of offshore structure platforms is a combination of steel structure
- Design methods and loads applied in harbours, such as waves, current and other parameters

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

COS NO.	**Course Outcomes**	**Bloom's level**
CO1	Classification and distribution of marine sediments	Understand
CO2	Design of suction piles for offshore structure.	Apply
CO3	Design a foundations types and design loads.	Apply
CO4	Analysis of pile driving	Analyse
CO5	Design of Lateral loading and dynamic response	Apply
CO6	Effects of soil instability on piles, installation and stability of submarine pipelines.	Understand

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	-	M	M	S	-	L	L	-	S	L	M
CO2	S	S	S	S	S	M	L	L	S	S	L	L
CO3	S	-	-	M	S	M	L	-	S	-	M	L
CO4	S	S	M	-	S	m	L	L	S	-	M	M
CO5	S	-	M	M	M	L	L	-	S	M	M	L
CO6	S	-	M	M	M	L	L	-	M	s	-	M
CO7	S	M	M	M	M	L	L	-	M	M	-	L

SYLLABUS:

MODULE I

THE NATURE OF SUBMARINE SOILS:

Origin, classification and distribution of marine sediments; in-situ stress state in submarine deposits; inorganic clay deposits; calcareous sediments; siliceous sediments. Offshore Geotechnical Investigations: phases of the investigation, geophysical survey, drilling and sampling procedures, in-situ testing techniques, laboratory testing.

MODULE II

FOUNDATIONS FOR OFFSHORE GRAVITY STRUCTURES:

Construction, installation, instrumentation of gravity platforms, stability analysis, deformation analysis based on elastic theory, piping and erosion. Design of suction piles for offshore structure.

MODULE III

FOUNDATIONS FOR JACK-UP RIGS

Foundations types and design loads, Prediction of individual footing performance, prediction of mat footing performance, seabed anchors, load capacity of anchors, breakout forces, anchor systems for floating structures.

MODULE IV

OFFSHORE PILE FOUNDATIONS

Types of offshore piles, temporary support of piled structures, dynamic analysis of pile driving, axial load capacity, axial deformation analysis, Lateral loading, and dynamic response.

MODULE V

SEAFLOOR STABILITY

Causes of seafloor instability, geological features of submarine slides, mechanisms of instability, slope stability under gravity forces and wave forces, Effects of soil instability on piles, installation and stability of submarine pipelines.

LEARNING RESOURCES:

Text Books:

1. Marine Geotechnics – H.G. Poulos (1988), Prentice Hall Inc.
2. Construction of marine and offshore structures – Ben C Gerwick, jr., CRC Press, Taylor and Francis Group.(2012)

References:

1. Seabed Reconnaissance and Offshore Soil Mechanics (for the installation of petroleum structures) – Pierre LE Tirant (1979), Gulf Publishing Company, Houston, Texas.
2. API (2000) – Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – API, RP2A.
3. Pile design and construction practice – M J Tomlinson, View point Publications, Palladian Publications Limited.(1987)
4. Port Engineering planning, construction, maintenance and security – George P T sinker.

Course Code:	ROCK MECHANICS	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To determine properties and behaviour of various types of rock under different loading conditions for underground and open excavations.
- Stress around mine openings, strain and displacement of rock Mass.

COURSE OUTCOMES:

- To determine the required rock properties
- Determination of bearing capacity of rocks,
- Checking the stability of slopes
- Design underground and open excavation.
- To evaluate rock reinforcement support and subsidence

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

COS NO.	Course Outcomes	Bloom's level
CO1	Classification of intact rocks.	Understand
CO2	Schmidt rebound hardness test.	Apply
CO3	Field permeability test.	Apply
CO4	Effect of confining pressure and Uniaxial Compressive strength	Understand
CO5	Estimation of bearing capacity, Stress distribution and Sliding stability of dam foundations	Understand
CO6	Design of Underground blast	Apply

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	--	M	M	M	M	L	-	-	S	M	M
CO2	S	S	-	S	S	M	-	L	S	S	-	M
CO3	S	-	S	-	-	M	L	-	S	-	M	M
CO4	S	S	S	S	M	L	L	L	S	-	-	M
CO5	S	S	-	-	M	L	-	-	S	-	M	M
CO6	S	-	S	S	M	L	L	L	-	S	L	M

SYLLABUS:

MODULE I

ENGINEERING CLASSIFICATION OF ROCKS

Classification of intact rocks, Rock mass classifications, Rock Quality Designation (RQD), Rock Structure Rating (RSR), Rock Mass Rating (RMR), Norwegian Geotechnical Classification (Q-system), Strength and modulus from classifications, Classification based on strength & modulus and strength and fracture strain, Geoengineering classification.

MODULE II

LABORATORY AND IN-SITU TESTING OF ROCKS

Physical properties, Compressive strength, Tensile strength, Direct shear test, Triaxial shear test, Slake durability test, Schmidt rebound hardness test, Sound velocity test, In-Situ Tests: Seismic methods, Electrical resistivity method, In situ stresses, Plate loading test, Goodman jack test, Plate jacking test, In-situ shear test, Field permeability test.

MODULE III

STRENGTH, MODULUS AND STRESSES-STRAIN RESPONSES OF ROCKS

Factors influencing rock response, Strength criteria for isotropic intact rocks, Modulus of intact rocks, effect of confining pressure, Uniaxial Compressive strength, Strength criteria for intact rocks, Strength due to induced anisotropy in rocks,. Stress Strain Models: Constitutive relationships, Elastic, Elasto-plastic, Visco-elastic, Elasto -plastic stress-strain models.

MODULE IV

STABILITY OF ROCK SLOPES AND FOUNDATIONS ON ROCKS

Rock slopes, Modes of failure, Rotational failure, Plane failure, Design charts, Wedge method of analysis, Buckling failure, Toppling failure, Improvement of slope stability and protection. Foundations on Rock: Introduction, Estimation of bearing capacity, Stress distribution, Sliding stability of dam foundations, strengthening measures, Settlements in rocks, Bearing capacity of pile/pier in rock, Remedial measures, Foundations located on edge of jointed slope.

MODULE V

UNDERGROUND AND OPEN EXCAVATIONS

Blasting operational planning, Explosive products, Blast Design, Underground blast design, Controlled blasting techniques, blasting damage and control, Safe practice with explosives and shots.

LEARNING RESOURCES:

Text Books:

1. Goodman – Introduction to Rock mechanics, Willey International (1980).
2. Ramamurthy, T. - Engineering in Rocks for slopes, foundations and tunnels, Prenice Hall of India. (2007)
3. Jaeger, J. C. and Cook, N. G. W. – Fundamentals of Rock Mechanics, Chapman and Hall, London.(1979)

References:

1. Hoek, E. and Brown, E. T. - Underground Excavation in Rock, Institution of Mining and Metallurgy, 1982.
2. Brady, B. H. G. and Brown, E. T. - Rock Mechanics for Underground Mining, Chapman & Hall, 1993.

Course Code:	ENVIRONMENTAL GEO-TECHNOLOGY	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To provide an exposure to the geotechnical nature of environmental problems
- To impart knowledge in the selection of sites for waste disposal using current methodologies
- To understand transport phenomena in saturated and partially saturated porous media
- To obtain knowledge on ground modification techniques

COURSE OUTCOMES:

- Apply the principles of geotechnical engineering aspects in waste disposal
- Select the suitable liner materials for protecting the ground and groundwater from leachates
- Know the site selection procedure for waste disposal
- Gain knowledge in ground improvement techniques
- An ability to know the soil testing methods

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

COS NO.	Course Outcomes	Bloom's level
CO1	Apply the principles of geotechnical engineering aspects in waste disposal	Apply
CO2	Select the suitable liner materials for protecting the ground and groundwater from leachates	Analysis
CO3	Know the site selection procedure for waste disposal	Understand
CO4	Gain knowledge in ground improvement techniques	Analysis
CO5	An ability to know the soil testing methods	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	--	M	M	M	M	L	-	-	S	M	M
CO2	S	S	L-	S	S	M	-	L	S	S	-	M
CO3	S	L	S	-	-	M	L	-	S	-	M	M
CO4	S	S	S	S	M	L	L	L	S	L	-	M
CO5	S	S	-	L	M	L	-	-	S	-	M	M

SYLLABUS:

MODULE I

INTRODUCTION TO ENVIRONMENTAL GEOTECHNIQUES AND SELECTION OF SITES

Environmental cycles and their interaction, Soil water environment interaction relating to geotechnical problems, Effect of population on soil, water behaviour. Criteria for selection of sites for wastes disposal current methodologies for waste disposal, Sub surface disposal techniques, Passive containment Systems, Leachate movement, application of geomembranes and other techniques in solid and liquid waste disposal. Landfill – Types and design.

MODULE II

TRANSPORT PHENOMENA

Transport phenomena in saturated and partially saturated porous media – contaminant migration and contaminant hydrology, Hydrological design for ground water pollution control, Ground water pollution downstream of landfills- pollution of aquifers by mining and liquid wastes – protection of aquifers

MODULE III

REMEDIATION OF HAZARDOUS WASTE AND CONTAMINATED SOIL

Hazardous waste control and storage system – stabilization / solidification of waste, Monitoring and performance of waste facilities – safe disposal of solid and Dynamic response of soil under environmental stress, Approach to remediate soils – attenuation – ex-situ and in situ remediation – S/S technique – bioremediation – incineration – washing – electrokinetics – soil heating – vitrification – bioventing and other methods

MODULE IV

GROUND MODIFICATION TECHNIQUES

Ground modification techniques in waste remedial measures for contaminated grounds, remediation technology, Bio-remediation

MODULE V

DETECTING AND TESTING METHODS

Methodology – current soil testing methods – approach for characterization and identification of contaminated ground soil for engineering purposes.

LEARNING RESOURCES:

Text Books:

1. Lakshmi Reddi, Hilary I. Inyang,(2000), “Geoenvironmental Engineering: Principles and Applications”, CRC Press, New York.

2. Hsai-Yang Fang,(2009), “Introduction to Environmental Geotechnology”, CRC Press, New York), “Introduction to Environmental Geotechnology”, CRC Press, New York.

References:

1. Wentz, C.A.,(2006), “Hazardous Waste Management”, McGraw Hill, Singapore.
2. Daniel,D.E.,(2012), “Geotechnical practice for waste disposal”, Chapman and Hall,London.
3. Ott, W.R.,(2008), “Environmental Indices”, Theory and Practice, Ann, Arbor, 2008.
4. Raymond N. Yong,(2000) Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate, and Mitigation, CRC Press, New York.

Course Code:	GROUND IMPROVEMENT TECHNIQUES	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Analyze the expansive soil properties and apply the same for the design of structures on expansive soils.
- Design dewatering system, and using dewatering methods for ground improvement
- Apply mechanical modification, using deep compaction Techniques, Blasting, Vibro compaction, Dynamic and Compaction Piles.
- Adapt physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology.
- Analyze the Stability analysis and Design of Reinforced earth retaining wall.

COURSE OUTCOMES:

- Analyze the field problems related to problematic soils and solve the problems using the ground Improvement techniques
- Design drainage for seepage control, Assess dewatering field problems.
- Summarize and practice ground improvement using Mechanical modification techniques
- Application of physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology.
- Demonstrate the ground improvement techniques such as ground anchors, rock bolting and soil nailing, Design of reinforced earth retaining structures

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

COS NO.	Course Outcomes	Bloom's level
CO1	Analyze the field problems related to problematic soils and solve the problems using the ground Improvement techniques	Analysis
CO2	Design drainage for seepage control, Assess dewatering field problems.	Apply
CO3	Summarize and practice ground improvement using Mechanical modification techniques	Understand, Apply Analysis
CO4	Application of physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology.	Apply
CO5	Demonstrate the ground improvement techniques such as ground anchors, rock bolting and soil nailing, Design of reinforced earth retaining structures.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	M	-	-	M	-	M	-	S	L	M
CO2	S	S	M	M	-	-	L	-	L	-	M	-
CO3	S	S	S	L	S	L	-	S	M	L	M	L
CO4	S	S	-	L	-	L	M	S	-	-	L	L
CO5	S	S	M	M	M	L	L	-	S	M	M	L

SYLLABUS:

MODULE I

PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES

Role of ground improvement in foundation engineering – methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.

MODULE II

DEWATEREING

Dewatering Techniques - Well points – Vacuum and electroosmotic methods – Seepage analysis for two – dimensional flow for fully and partially penetrated slots in homogeneous deposits - Simple cases - Design.

MODULE III

INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS

Insitu densification of cohesion-less soils and consolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns and Lime piles-installation techniques – simple design - relative merits of above methods and their limitations.

MODULE IV

EARTH REINFORCEMENT

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall –Mechanism – simple design - applications of reinforced earth. Role of Geotextiles in filtration, drainage, separation, road works and containment.

MODULE V

GROUT TECHNIQUES

Types of grouts – Grouting equipments and machinery – injection methods – Grout monitoring – stabilization with cement, lime and chemicals – stabilization of expansive soil.

LEARNING RESOURCES:

Text Books:

1. Purushothama Raj. P, “Ground Improvement Techniques”, Firewall Media, 2005.
2. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, 1994.

References:

1. Moseley, M.P., “Ground Improvement Blockie Academic and Professional”, Chapman and Hall, Glasgow, 1998.
2. Jones J.E.P. “Earth Reinforcement and Soil Structure”, Butterworths, London, 1985.
3. Winterkorn, H.F. and Fang, H.Y. “Foundation Engineering Hand Book”. Van Nostrand Reinhold, 1994.
4. Das, B.M. – “Principles of Foundation Engineering” (seventh edition),
5. Cengage learning,2010.
6. Coduto, D.P. “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India Pvt.Ltd. New Delhi, 2011.
7. Koerner, R.M. “Designing with Geosynthetics” (Fourth Edition),. Prentice Hall, Jersey, 1999.
9. IS Code 9759 : 1981 (Reaffirmed 1998) “Guidelines for Dewatering During Construction”, Bureau of Indian Standards, New Delhi.
10. IS Code 15284(Part 1) : 2003 “Design and Construction for Ground Improvement –Guidelines” (Stone Column), Bureau of Indian Standards, New Delhi.

PROFESSIONAL ELECTIVE COURSE – II

(Construction Engineering & Management)

A. Building Construction Practice
B. Construction Project Planning & Systems
C. Sustainable Construction Methods
D. Contracts Management
E. Repairs & Rehabilitation of Structures

PEC II – (Construction Engineering & Management)

Course Code:	BUILDING CONSTRUCTION PRACTICES	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- The main objective of this course is to make the student aware of the various construction techniques, practices and the equipment needed for different types of construction activities.
- At the end of this course the student shall have a reasonable knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.

COURSE OUTCOMES:

- Know the different construction techniques and structural systems
- Understand various techniques and practices on masonry construction, flooring, and roofing.
- Plan the requirements for substructure construction.
- Know the methods and techniques involved in the construction of various types of super structures
- Select, maintain and operate hand and power tools and equipment used in the building construction sites.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Know the different construction techniques and structural systems	Understand & Remember
CO2	Understand various techniques and practices on masonry construction, flooring, and roofing.	Understand & Remember
CO3	Plan the requirements for substructure construction.	Analysis& Apply
CO4	Know the methods and techniques involved in the construction of various types of super structures	Understand & Remember
CO5	Select, maintain and operate hand and power tools and equipment used in the building construction sites.	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	S	L	M	M	-	M	-	-	-	S
CO2	S	-	M	M	S	M	-	M	-	-	-	S
CO3	S	L	L	L	M	L	-	L	-	-	-	M
CO4	S	-	S	M	S	S	-	M	-	-	-	S
CO5	L	-	S	M	S	M	-	S	-	-	-	S

SYLLABUS:

MODULE I

CONSTRUCTION TECHNIQUES

Structural systems - Load Bearing Structure - Framed Structure - Load transfer mechanism – floor system - Development of construction techniques - High rise Building Technology - Seismic effect - Environmental impact of materials – responsible sourcing - Eco Building (Green Building) - Material used - Construction methods - Natural Buildings - Passive buildings - Intelligent(Smart) buildings - Meaning - Building automation - Energy efficient buildings for various zones-Case studies of residential, office buildings and other buildings in each zones.

MODULE II

CONSTRUCTION PRACTICES

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick –– weather and water proof – roof finishes – acoustic and fire protection.

MODULE III

SUB STRUCTURE CONSTRUCTION

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting - driving diaphragm walls, sheet piles - shoring for deep cutting - well points - Dewatering and stand by Plant equipment for underground open excavation.

MODULE IV

SUPER STRUCTURE CONSTRUCTION

Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks.

MODULE V

CONSTRUCTION EQUIPMENT

Selection of equipment for earth work - earth moving operations - types of earthwork equipment - tractors, motor graders, scrapers, front end waders, earth movers – Equipment for foundation and pile driving. Equipment for compaction, batching, mixing and concreting - Equipment for material handling and erection of structures – types of cranes - Equipment for dredging, trenching, tunneling,

LEARNING RESOURCES:

Text books :

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", 5th Edition, McGraw Hill, Singapore, 1995.
2. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 1997.
3. Varghese, P.C. "Building construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2007.

References:

1. Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 1999.
2. Sharma S.C. “Construction Equipment and Management”, Khanna Publishers New Delhi, 2002.
3. Deodhar, S.V. “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi, 2012.
4. Mahesh Varma, “Construction Equipment and its Planning and Application”, Metropolitan Book Company, New Delhi, 1983.

Course Code:	CONSTRUCTION PROJECT PLANNING & SYSTEMS	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- At the end of this course the student is expected to have learnt how to plan construction projects, schedule the activities using network diagrams, determine the cost of the project, control the cost of the project by creating cash flows and budgeting and how to use the project information as an information and decision-making tool.

COURSE OUTCOMES:

- Understand basic concepts of construction planning.
- Schedule the construction activities.
- Forecast and control the cost in a construction.
- Understand the quality control and safety during construction.
- Organize information in Centralized database Management systems.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Understand basic concepts of construction planning.	Understand & Remember
CO2	Schedule the construction activities.	Understand & Remember
CO3	Forecast and control the cost in a construction.	Analysis & Apply
CO4	Understand the quality control and safety during construction.	Understand & Remember
CO5	Organize information in Centralized database Management systems.	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		-	L	M	M	-	M	-	-	M	M
CO2	L	M	-	M	M	M	-	M	-	-	S	S
CO3	L	M	-	L	M	L	-	L	-	-	S	M
CO4	M		-	M	S	S	-	M	-	-	S	S
CO5	L:		-	M	S	M	-	S	-	-	M	M

SYLLABUS:

MODULE I

CONSTRUCTION PLANNING

Basic concepts in the development of construction plans-choice of Technology and Construction method-Defining Work Tasks- Definition- Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems.

MODULE II

SCHEDULING PROCEDURES AND TECHNIQUES 12

Relevance of construction schedules-Bar charts - The critical path method-Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows-Calculations for scheduling with leads, lags and windows-Resource oriented scheduling-Scheduling with resource constraints and precedences -Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost trade offs -Improving the Scheduling process – Introduction to application software.

MODULE III

COST CONTROL MONITORING AND ACCOUNTING

The cost control problem-The project Budget-Forecasting for Activity cost control - financial accounting systems and cost accounts-Control of project cash flows-Schedule control-Schedule and Budget updates-Relating cost and schedule information.

MODULE IV

QUALITY CONTROL AND SAFETY DURING CONSTRUCTION

Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.

MODULE V

ORGANIZATION AND USE OF PROJECT INFORMATION

Types of project information-Accuracy and Use of Information-Computerized organization and use of Information -Organizing information in databases-relational model of Data bases-Other conceptual

Models of Databases-Centralized database Management systems-Databases and application programs-Information transfer and Flow.

LEARNING RESOURCES:

Text Books:

1. Chitkara, K.K. “Construction Project Management Planning”, Scheduling and Control, Tata McGraw-Hill Publishing Co., New Delhi, 1998.

2. Srinath,L.S., “PERT and CPM Priniples and Applications “, Affiliated East West Press, 2001

References:

1. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamentals Concepts for Owners”, Engineers, Architects and Builders, Prentice Hall, Pitsburgh, 2000.

2. Moder.J., C.Phillips and Davis, “Project Management with CPM”, PERT and Precedence Diagramming, Van Nostrand Reinhold Co., Third Edition, 1983.

3. Willis., E.M., “Scheduling Construction projects”, John Wiley and Sons 1986.

4. Halpin,D.W., “Financial and cost concepts for construction Management”, John Wiley and Sons, New York, 1985.

Course Code:	SUSTAINABLE CONSTRUCTION METHODS	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

OBJECTVE

- To study and understand the properties of sustainable building materials and construction methods used and understand the importance of bio materials and green building materials.

OUTCOMES

- know the different crisis that leads to global warming
- Understand various construction practices.
- Know the green materials and technology adopted to renew the energy construction.
- Know the rating procedure involved in the construction of green building
- Understand the selecting procedure for green materials and ideology for construction

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

COS NO.	Course Outcomes	Bloom's level
CO1	know the different crisis that leads to global warming	Understand & Remember
CO2	Understand various construction practices.	Understand & Remember
CO3	Know the green materials and technology adopted to renew the energy construction.	Understand & Apply
CO4	Know the rating procedure involved in the construction of green building	Understand & Remember
CO5	Understand the selecting procedure for green materials and ideology for construction	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	S	L	-	M	-	M	-	M	-	S
CO2	S	-	M	M	L	M	-	M	-	S	-	S
CO3	S	L	L	L	-	L	-	S	-	S	-	M
CO4	S	-	S	M	-	S	-	S	-	S	-	S
CO5	L:	-	S	M	-	M	-	S	-	S	-	S

SYLLABUS:

MODULE I

INTRODUCTION

Global environmental crisis - Ozone depletion - Resource extraction - Transport congestion - Sprawl- Water pollution - Toxic pollution - Waste accumulation – Key role of construction sector in ensuring sustainability.

MODULE II

SUSTAINABLE BUILDING – PRACTICE THEORY

Sustainable building systems and environmental impacts - 5Es of sustainability - Scales and program diversity of buildings – Stages of environmental assessment and intervention - Whole life costing and Life cycle analysis – Carbon foot print – Integrated design approach — Sustainable materials, old and new - Cultural context, holistic building traditions and invention - Cradle to Cradle – Bio mimicry – Resource abundance by design - Recycling and reuse

MODULE III

GREEN BUILDING MATERIALS AND TECHNOLOGY

Introduction, green building product and materials – Bio materials : Properties, application, specification and standards(Indian and International) - Bio materials from industrial waste, mining waste, mineral waste, agricultural waste.

MODULE IV

GREEN BUILDING RATING SYSTEMS AND CODES

Green building rating systems: BREAM, LEED and GRIHA, ISO 14020 – Green building codes : ECBC and NBC 2005 - Green materials : standard specifications

MODULE V

PRODUCT SELECTION CRITERIA AND CASE STUDIES

Concrete, eco block, insulated concrete forms (ISF), hydra form, prefabs / structural insulating panels, cellulose insulation, adobe, rammed earth, earth sheltered and recycled materials

Case Studies: Projects of William Mcdonough, Glenn Murcutt, Jeanne Gang, Ken Yeang, Karan Grover, Charles Correa, Nari Gandhi – Rural Studio: Auburn University, Solar Decathlon.

LEARNING RESOURCES:

Text Books:

1. Martin Evans – Housing, Climate and Comfort, Architectural Press, London, 1980
2. Vinod Gupta (Editor) – Energy and Habitat, Wiley Eastern Limited, India, 1984
3. David Wright & Dennis A.Andrejko - Passive Solar Architecture, Van Nostrand Reinhold Company, U.S.A, 1982
4. Arvind Krishna & others – Climate responsive Architecture, Tata McGraw Hill, 2004
5. Brown G.Z. & Mark Dekay – Sun, wind and Light – Architectural design strategies (second edition,John Wiley and sons, U.S.A., 2001

References:

1. Richard Hyde – Climate Responsive Design, E&FN Spon, London & New York, 2000
2. Braham W. and D. Willis (Eds). Architecture & Energy. Routledge., 2013
3. Simos Yannas & Willi Weber (Eds.)., Lessons from Vernacular Architecture, Earthscan / Routledge, 2013
4. William McDonough, Cradle to Cradle: Remaking the Way We Make Things, North point press, 2002
5. Jeanne Gang-Reveal, Studio Gang Architects, Princeton Architectural Press, 2002

Online resources:

1. http://www.ruralstudio.org/
2. http://www.solardecathlon.gov/

Course Code:	CONTRACTS MANAGEMENT	L	T	P	Credit	CIA Marks **40**
Course Category: **PEC**		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To expose the students to the process selection of contract types, various international and national contract forms, Pre-qualification of contractors, Preparation of contract documents, Evaluation of contract bids, Alternate dispute resolution, issues related to contract administration, etc

COURSE OUTCOMES:

- Knowing the legal governance of Construction administration
- Understand the contracts, various types of contract and its procedure.
- Understand the Tender documentation and its byelaws.
- Know the contract administration issues and solution making.
- Understand the problem-solving ideas on disputes and Arbitration procedure.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Knowing the legal governance of Construction administration	Understand & Remember
CO2	Understand the contracts, various types of contract and its procedure.	Understand
CO3	Understand the Tender documentation and its byelaws.	Analysis & Apply
CO4	Know the contract administration issues and solution making.	Understand
CO5	Understand the problem-solving ideas on disputes and Arbitration procedure.	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	-	L	-	M	-	M	S	-	-	M
CO2	L	-	-	M	-	M	-	M	M	-	-	M
CO3	M	-	-	L	-	L	-	S	S	-	-	S
CO4	L	-	-	M	-	S	-	M	M	-	-	S
CO5	L	-	-	M	-	S	-	S	S	-	-	S

SYLLABUS:

MODULE I

LEGAL FRAME WORK

Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes –Tax Laws – Insurance and Bonding –Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations Indian

MODULE II

CONTRACT

Contracts Act – Types of Contracts – formation of contracts - Elements of Contracts – potential contractual problems – contracts for engineering and architectural services – contracts for construction. Introduction to construction Contract Documents – drawings as construction contract document –specifications as construction document – construction contract conditions – introduction to construction specification.

MODULE III

TENDERS

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – World Bank Procedures and Guidelines – Tamil Nadu Transparency in Tenders Act.

MODULE IV

CONTRACT ADMINISTRATION ISSUES.

Introduction – duties of employer, contractor, interpretation of contract, Breach of contract – changes during the contract – changes dealing with differing site conditions – Force majeure – delay analysis - – claims - cost escalation – time delays and extensions, compensation, notices and termination.

MODULE V

DISPUTES AND ARBITRATION.

Types of disputes in construction contracts – methods of dispute resolution processes – alternative dispute resolution and dispute review mechanisms – arbitration and conciliation act 1996 –managerial approach to dispute minimization – conduct of arbitration proceedings – arbitration award and termination proceedings – powers of arbitrator – setting aside of awards and enforcement of awards – appeal, revision and court proceedings.

LEARNING RESOURCES:

Text Books:

1. Gajaria G.T and Kishore Gajaria, Laws Relating to Building and Engineering Contracts in India, LexisNexis Butterworths India, 2000

2. Jimmie Hinze, Construction Contracts, 3rd Edition, McGraw-Hill, 2010

References:

1. Joseph Bockrath and Fredric Plotnick Contracts and the Legal Environment for Engineers and Architects, 6th Edition, McGraw-Hill, 2010

2. Kwaku A. Tenah and Jose M Guevara., Fundamentals of construction Management and organization, Reston Publishing Company, 1985

3. Construction Specifications Institute, Construction Contract Administration Practice Guide, John Wiley & Sons, 2011 6. Greg Goldfay, Construction Contract Administration, UNSW Press, 2004

Course Code:	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

OBJECTIVE:

- To acquire the knowledge on Quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.

OUTCOMES:

- the importance of maintenance and assessment method of distressed structures.
- the strength and durability properties ,their effects due to climate and temperature.
- recent development in concrete
- the techniques for repair rand protection methods
- repair, rehabilitation and retrofitting of structures and demolition methods.

Students will be able to understand

COS NO.	Course Outcomes	Bloom's level
CO1	The importance of maintenance and assessment method of distressed structures.	Understand & Remember
CO2	The strength and durability properties, their effects due to climate and temperature.	Understand & Remember
CO3	Recent development in concrete	Understand & Apply
CO4	The techniques for repair rand protection methods	Understand, Remember & Apply
CO5	Repair, rehabilitation and retrofitting of structures and demolition methods.	Understand, Remember & Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	L	L	M	M	-	M	-	-	-	S
CO2	S	-	M	M	S	M	-	M	-	-	-	S
CO3	S	L	L	L	M	L	-	S	-	-	-	M
CO4	S	-	L	M	S	S	-	S	-	-	-	S
CO5	L	-	L	M	S	M	-	S	-	-	-	S

SYLLABUS:

MODULE I

MAINTENANCE AND REPAIR STRATEGIES

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspectsof Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration.

MODULE II

STRENGTH AND DURABILITY OF CONCRETE

Quality assurance for concrete–Strength, Durability- Cracks, different types, causes–Effects due to climate, temperature, Sustained elevated temperature, Corrosion

MODULE III

SPECIAL CONCRETES

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

MODULE IV

TECHNIQUES FOR REPAIR AND PROTECTION METHODS

Non-destructive Testing Techniques, Load Test for Stability-Epoxy injection, Shoring, Underpinning, Corrosion protection techniques–Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

MODULE V

REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake-Transportation of Structures from one place to other –Structural Health Monitoring-demolition techniques-Engineered demolition methods-Case studies

LEARNING RESOURCES:

Text books:

1. Shetty.M.S.ConcreteTechnology-Theory and Practice,S.Chandand Company, 2008.

2. Vidivelli.B Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.

3. Varghese.P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014. 4. Dodge Woodson.R Concrete Structures, Protection, Repair and Rehabilitation, Butterworth- Heinemann,Elsevier,New Delhi 2012

References:

1. DovKominetzky.M.S.,-Design and Construction Failures, Galgotia,Publications Pvt.Ltd.,2001

2. Ravishankar.K. Krishnamoorthy.T.S, Structural Health Monitoring, Repair And Rehabilitation of Concrete Structures, Allied Publishers, 2004. www.padeepz.net Padeepz App Padeepz App 115

3. Hand book on Seismic Retrofit of Buildings,CPWD and Indian Buildings Congress, Narosa Publishers, 2008.

4. Hand Book on “Repair and Rehabilitation of RCC Buildings”–Director General works CPWD ,Govt of India , New Delhi–2002

PROFESSIONAL ELECTIVE COURSE – III

(Transportation Engineering)

A. Pavement Design
B. Public Transportation Systems
C. Traffic Engineering and Management
D. Urban Transportation Planning
E. Geometric Design of Highways
F. Highway Construction and Management
G. Railway Engineering

PEC - III TRANSPORTATION ENGINEERING

Course Code:	PAVEMENT DESIGN	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements. Further, the student will be in a position to assess quality and serviceability conditions of roads.

COURSE OUTCOMES:

- Get knowledge about types of rigid and flexible pavements.
- Able to design of rigid pavements.
- Able to design of flexible pavements
- Determine the causes of distress in rigid and flexible pavements.
- Understand stabilization of pavements, testing and field control.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Get knowledge about types of rigid and flexible pavements	Understand
CO2	Able to design of rigid pavements.	Analysis
CO3	Able to design of flexible pavements	Apply
CO4	Determine the causes of distress in rigid and flexible pavements.	Remember
CO5	Understand stabilization of pavements, testing and field control.	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	L	---	---	L	L	L	L	L	---	L
CO2	M	S	S	L	L	L	L	L	L	L	---	L
CO3	M	S	S	L	L	L	L	L	L	L	---	L
CO4	L	---	---	---	---	L	S	L	L	M	M	M
CO5	L	---	---	---	---	L	S	L	L	M	M	M

SYLLABUS:

MODULE I

TYPE OF PAVEMENT AND STRESS DISTRIBUTIONON LAYERED SYSTEM

Introduction – Pavement as layered structure – Pavement types rigid and flexible. Resilient modulus - Stress and deflections in pavements under repeated loading. wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels.

MODULE II

DESIGN OF FLEXIBLE PAVEMENTS

Flexible pavement design Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.

MODULE III

DESIGN OF RIGID PAVEMENTS

Cement concrete pavements Factors influencing CC pavements – Modified Western guard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.

MODULE IV

PERFORMANCE EVALUATION AND MAINTENANCE

Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).

MODULE V

STABILIZATION OF PAVEMENTS

Stabilisation with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilisation for rural roads in India – Use of Geo-synthetics in roads.

LEARNING RESOURCES:

Text Books:

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, “Highway Engineering”, New Chand and Brothers, Revised 10th Edition, 2014.
2. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khanna tech. Publications, New Delhi, 2005.

References:

1. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley 2000.
2. Guidelines for the Design of Flexible Pavements,IRC-37–2001,The Indian roads Congress, New Delhi. 3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-1998, The Indian Road Congress, New Delhi.

Course Code:	**PUBLIC TRANSPORTATION SYSTEM**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Student gains knowledge on various public transportation system. Further, the student will be in a position to assess quality and serviceability conditions of public transportation system.

COURSE OUTCOMES:

- Get knowledge about Public Transport:
- Get knowledge about Transit Network Planning:
- Get knowledge about Transit Scheduling:
- Get knowledge about Organizational structure of Transportation system
- Get knowledge about Design of Facilities

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

COS NO.	**Course Outcomes**	**Bloom’s level**
CO1	Get knowledge about public transport	Understand
CO2	Get knowledge about transit network planning	Remember
CO3	Get knowledge about transit scheduling	Apply
CO4	Get knowledge about organizational structure of Transportation system	Remember
CO5	Get knowledge about design facilities	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	---	---	L	---	M	M	M	L	M	---	S
CO2	M	L	---	L	L	L	M	L	M	M	L	S
CO3	M	L	---	L	L	L	S	L	L	M	L	S
CO4	L	L	---	---	---	M	M	L	L	M	---	M
CO5	M	M	S	S	M	L	M	L	M	S	L	M

SYLLABUS:

MODULE I

PUBLIC TRANSPORT

Definitions, modes of public transport and comparison, public transport travel characteristics, trip chaining, technology of bus, rail, rapid transit systems, basic operating elements.

MODULE II

TRANSIT NETWORK PLANNING

Planning Objectives, principles, considerations, transit lines – types, geometry and characteristics, transit routes and their characteristics, timed transfer networks, prediction of transit usage, evaluation of network, accessibility considerations.

MODULE III

TRANSIT SCHEDULING

Components of scheduling process, determination of service requirements, scheduling procedure, marginal ridership, crew scheduling; Transit Agency and Economics.

MODULE IV

ORGANIZATIONAL STRUCTURE OF TRANSPORTATION SYSTEM

Organizational structure of transit agency, management and personnel, transit system statistics, performance and economic measures, operations, fare structure.

MODULE V

DESIGN OF FACILITIES

Design of bus stops, design of terminals – principles of good layout, types of layout, depot location, twin depot concept, crew facilities and amenities.

LEARNING RESOURCES:

Text Books:

1. 1. George E. Gray and Lester A. Hoel. “Public Transportation”, Prentice Hall, New Jersey.
2. Urban Transportation Planning, by Michael Meyer, Eric Miller, McGraw Hill

References:

1. 1 Urban Transit Systems and Technology John Wiley and Sons, 2007.
2. Transit Capacity and Quality of Service Manual, 2nd Edition, Transportation Research Board
3. Traffic Engineering, by Roger P. Roess, Elena S. Prassas, and William R. McShane, 3rd Edition, 2004

Course Code:	**TRAFFIC ENGINEERING AND MANAGEMENT**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To give an overview of Traffic engineering, traffic regulation, management and traffic safety with integrated approach in traffic planning as well.

COURSE OUTCOMES:

- Knowledge about Traffic Planning and Characteristics
- Knowledge about Traffic Surveys
- Knowledge about Traffic Design and Visual Aids
- Knowledge about Traffic Safety and Environment
  Knowledge about Traffic Management
  After the successful completion of the course students will be able to

COS NO.	**Course Outcomes**	**Bloom’s level**
CO1	Knowledge about Traffic Planning and Characteristics	Understand
CO2	Knowledge about Traffic surveys	Analysis
CO3	Knowledge about Traffic design and visual aids	Apply
CO4	Knowledge about Traffic safety and environment	Remember
CO5	Knowledge about Traffic management	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	M	M	---	L	S	M	M	S	---	S
CO2	M	M	M	M	L	L	M	M	L	M	---	M
CO3	M	S	S	M	M	L	M	L	L	M	---	S
CO4	M	L	M	M	L	S	S	S	L	S	S	S
CO5	M	L	M	L	L	S	S	S	M	S	M	M

SYLLABUS:

MODULE I

TRAFFIC PLANNING AND CHARACTERISTICS

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town ,country ,regional and all urban infrastructure – Towards Sustainable approach. – land use & transport and modal integration

MODULE II

TRAFFIC SURVEYS

Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including nonmotorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

MODULE III

TRAFFIC DESIGN AND VISUAL AIDS

Intersection Design - channelization, Rotary intersection design – Signal design – Coordination of signals –– Grade separation - Traffic signs including VMS and road markings – Significant roles of traffic control personnel - Networking pedestrian facilities & cycle tracks.

MODULE IV

TRAFFIC SAFETY AND ENVIRONMENT

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

MODULE V

TRAFFIC MANAGEMENT

Area Traffic Management System - Traffic System Management (TSM) with IRC standards –- Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education

LEARNING RESOURCES:

Text Books:

1. Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2013

2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.

3. Salter. R.I and Hounsell N.B, "Highway Traffic Analysis and design", Macmillan Press Ltd. 1996.

References:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011

2. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning,New Delhi, 2010

3. SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994

4. John E Tyworth, "Traffic Management Planning, Operations and control", Addison Wesly Publishing Company, 1996

5. Hobbs.F.D. "Traffic Planning and Engineering", University of Brimingham, Peragamon Press Ltd, 2005

6. Taylor MAP and Young W, "Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998.

Course Code:	URBAN TRANSPORTATION PLANNING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Student gains knowledge on various Urban Transportation Planning, Further, the student will be in a position to assess quality and serviceability conditions of Urban Transportation Planning**.**

COURSE OUTCOMES:

- Get knowledge about Urban morphology
- Get knowledge about Urban Transportation Planning
- Get knowledge about Trip generation models
- Get knowledge about Traffic assignment
- Get knowledge about Non-Transport solutions for transport problems

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

COS NO.	Course Outcomes	Bloom's level
CO1	Get knowledge about Urban morphology	Understand
CO2	Get knowledge about Urban Transportation Planning	Understand
CO3	Get knowledge about Trip generation models	Analysis
CO4	Get knowledge about Traffic assignment	Remember
CO5	Get knowledge about Non-Transport solutions for transport problems	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	---	L	S	M	M	S	---	S
CO2	M	S	M	M	M	L	M	M	L	M	---	M
CO3	M	S	S	M	M	L	M	L	L	M	L	S
CO4	M	L	M	M	---	L	M	S	L	M	L	S
CO5	L	L	M	L	L	M	S	S	M	S	M	M

SYLLABUS:

MODULE I

URBAN MORPHOLOGY

Urban morphology - Urbanization and travel demand –Urban activity systems and travel patterns – Systems approach – Trip based and Activity based approach –

MODULE II

URBAN TRANSPORTATION PLANNING

Goals, Objectives and Constraints -Inventory, Model building, Forecasting and Evaluation - Study area delineation – Zoning -UTP survey

MODULE III

TRIP GENERATION MODELS

Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis - Trip distribution models –Growth factor models, Gravity model and Opportunity modes; Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models – Utility functions - Logit models - Two stage model.

MODULE IV

TRAFFIC ASSIGNMENT

Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior; Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models - Quick response techniques –

MODULE V

NON-TRANSPORT SOLUTIONS FOR TRANSPORT PROBLEMS

Preparation of alternative plans - Evaluation techniques – Plan implementation - Monitoring - Financing of Project – urban development planning policy -Case studies

LEARNING RESOURCES:

Text Books:

1. 1. George E. Gray and Lester A. Hoel. “Public Transportation”, Prentice Hall, New Jersey.
2. Vukan R Vuchic, “Urban Public Transportation Systems and Technology”, Prentice Hall Inc., New Jersey
3. Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss,' City Traffic - A Systems Digest', Van Nostrand Reinhold Company, New York
4. John W. Dickey,' Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co. New Delhi.

References:

1. 1. Robert F Baker, (Eds) "Hand Book of Highway Engineering, Van Nostrand Reinhold Company, New York, 1975
2. New Jersy, "Transportation and Traffic Engineering Hand Book, Institute of Transportation Engineers, Prentice Hall, INC, 1982
3. Kanna, S.K. and Justo, C.E.G. "Highway Engineering, Nemchand and Brothers, Roorkee, 1998

Course Code:	GEOMETRIC DESIGN OF HIGHWAYS	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements. Further, the student will be in a position to assess quality and geometric design of highways.

COURSE OUTCOMES:

- Get knowledge about types of rigid and flexible pavements.
- Able to design horizontal alignment of pavements.
- Able to design vertical alignment of pavements
- Get knowledge about guide lines for design of pavements
  Get knowledge about design considerations for pavements

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

COS NO.	Course Outcomes	Bloom's level
CO1	Get knowledge about types of rigid and flexible pavements	Understand
CO2	Able to design horizontal alignment of pavements.	Analysis
CO3	Able to design vertical alignment of pavements	Analysis
CO4	Get knowledge about guide lines for design of pavements	Remember
CO5	Get knowledge about design considerations for pavements	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	M	---	L	M	L	M	S	L	S
CO2	M	S	S	M	L	L	L	M	L	M	---	M
CO3	M	S	S	M	L	L	L	M	L	M	---	M
CO4	M	S	S	M	L	S	L	L	L	M	L	S
CO5	M	S	S	M	L	S	L	L	M	M	L	M

SYLLABUS:

MODULE I

INTRODUCTION AND CLASSIFICATION OF HIGHWAYS

Introduction: Classification of rural highways and urban roads. Objectives and requirements of highway geometric design; Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors;

MODULE II

DESIGN OF HORIZONTAL ALIGNMENT

Design Elements: Sight distances, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections,

MODULE III

DESIGN OF VERTICAL ALIGNMENT

Vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems;

MODULE IV

GUIDELINES FOR DESIGN PROBLEMS

Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness;

MODULE V

DESIGN CONSIDERATIONS

Design considerations for rural and urban arterials, freeways, and other rural and urban roads; Design Of Intersections: Characteristics and design considerations of at-grade intersections;; Rotary intersections; Grade separations and interchanges -; Design of Parking lots

.

LEARNING RESOURCES:

Text Books:

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, “Highway Engineering”, New Chand and Brothers, Revised 10th Edition, 2014.
2. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khanna tech. Publications, New Delhi, 2005.

References:

1. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley 2000.
2. Guidelines for the Design of Flexible Pavements,IRC-37–2001,The Indian roads Congress, New Delhi. 3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-1998, The Indian Road Congress, New Delhi.

Course Code:	HIGHWAY CONSTRUCTION AND MANAGEMENT	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

Student gains knowledge on Pavement Construction and Management**,** Further, the student will be in a position to assess quality and procedures of Pavement Construction and Management

COURSE OUTCOMES:

- Get knowledge about Flexible Pavement Construction
- Get knowledge about Cement Concrete Pavement Construction
- Get knowledge about Design factors for pavement construction
- Get knowledge about Pavement Evaluation
- Get knowledge about Pavement Management Systems

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

COS NO.	Course Outcomes	Bloom's level
CO1	Get knowledge about Flexible Pavement Construction	Understand
CO2	Get knowledge about Cement Concrete Pavement Construction	Remember
CO3	Get knowledge about Design factors for pavement construction	Apply
CO4	Get knowledge about Pavement Evaluation.	Analysis
CO5	Get knowledge about Pavement Management Systems .	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	M	---	L	M	L	M	S	L	S
CO2	M	S	S	M	L	L	L	M	L	M	S	M
CO3	L	S	S	S	L	L	L	M	L	M	S	M
CO4	L	S	S	S	L	S	L	L	L	M	S	S
CO5	M	S	S	M	L	S	L	L	M	M	S	M

SYLLABUS:

MODULE I

FLEXIBLE PAVEMENT CONSTRUCTION

Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in subbase, base, binder and surface course layers and their choice;

MODULE II

CEMENT CONCRETE PAVEMENT CONSTRUCTION

Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints; Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soilaggregate mixes and compaction;

MODULE III

DESIGN FACTORS FOR PAVEMENT CONSTRUCTION

Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and applications;

MODULE IV

PAVEMENT EVALUATION

Pavement Distress - Functional and structural condition of pavements, Pavement distress survey, Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - nondestructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques;

MODULE V

PAVEMENT MANAGEMENT SYSTEMS

Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques– AASTHO, CRRI and HDM models, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, life cycle costing,

LEARNING RESOURCES:

Text Books:

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, "Highway Engineering", New Chand and Brothers, Revised 10th Edition, 2014.
2. Ralph Haas, W.Ronald Hudson and John Zaniewski, Modern Pavement Management, Kreigar Publishing Company, New York, 1994.
3. M.Y.Stalin, Chapman and Hall Pavement Management for Airports, Roads and Parking Lots , New York, 1992.
4. Michael Sargious, Pavements and Surfacings for Highways and Airports, AppliedScience Publishers Limited, London, 1975

References:

1. Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000.

2. Guidelines for the Design of Flexible Pavements,IRC-37–2001,The Indian roads Congress, New Delhi. 3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-1998, The Indian Road Congress, New Delhi.

Course Code:	**RAILWAY ENGINEERING**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand about construction of railway track.
- To understand about railway design.
- To understand about planning and construction of railway.
- To understand about maintenance and operation of railway.
- To understand about signalling in railway.

COURSE OUTCOMES:

- Knowledge about construction of railway track.
- An idea about railway design.
- Understand about planning and construction of railway.
- Complete knowledge about maintenance and operation of railway.
- Understand about signalling in railway.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Knowledge about construction of railway track.	Understand
CO2	An idea about railway design.	Analysis
CO3	Understand about planning and construction of railway.	Understand
CO4	Complete knowledge about maintenance and operation of railway	Remember
CO5	Understand about signalling in railway.	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	---	L	L	S	M	L	L	M	S	S
CO2	M	S	S	L	M	M	L	M	L	M	L	M
CO3	L	L	L	S	---	L	L	L	M	M	S	S
CO4	L	L	---	L	---	L	S	L	L	M	S	M
CO5	L	L	L	L	S	M	M	L	L	L	M	M

SYLLABUS:

MODULE I

RAILWAY PLANNING

Significance of Rail transports - Coordination of all modes to achieve sustainability. Role of Indian Railways in National Development. Engineering Survey for Track Alignment. - Permanent way Components and Functions of Each Component, Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, - Track Stress, coning of wheels, creep in rails, defects in rails Permanent Way, Gauges in Railway Tracks.

MODULE II

RAILWAY DESIGN

Route alignment surveys, conventional and modern methods- - Soil suitability analysis Geometric Design of Railway Tracks – Gradient, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Vertical Curves and Grade Compensation (Derivations of formulae and Problems)

MODULE III

RAILWAY TRACK CONSTRUCTION,

Earthwork – Stabilization of track on poor soil –- Tunneling Methods, drainage and ventilation –- Calculation of Materials required for track laying - Construction tracks – Modern methods of

construction - Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.

MODULE IV

RAILWAY OPERATION AND MAINTENANCE

Construction and maintenance of tracks – Modern methods of maintenance - Track maintenance and Materials. Track Drainage. Lay outs of Railway Stations and Yards. rail joints and welding of rails; track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations and yards.

MODULE V

RAILWAY SIGNALING

Signalling and interlocking; maintenance of railways and high speed trains. Points and Crossings, Signalling, Interlocking and Track Circuiting, Construction and Maintenance – Conventional and Modern methods (Remote Sensing, GIS & GPS) for Railway Alignment.

LEARNING RESOURCES:

Text Books:

1. Saxena Subhash C and Satyapal Arora, A Course in Railway Engineering, Dhanpat Rai and Sons, Delhi, 1998.
2. Satish Chandra and Agarwal M.M, "Railway Engineering", 2 nd Edition, Oxford University Press, New Delhi, 2013
3. J.S Mundrey Railway track Engineering Tata McGraw-Hill Education, 2009

References:

1. Rangwala, Railway Engineering, Charotar Publishing House, 1995.
2. Professor V A Profillidis Railway engineering and Management Ashgate Publishing, Ltd., 28-Jun-2014

PROFESSIONAL ELECTIVE COURSE – IV

(Hydraulics, Hydrology & Water Resources Engineering)

A. Design of hydraulic structures
B. Irrigation Engineering
C. Groundwater Engineering
D. Surface water hydrology

PEC - IV HYDRAULICS, HYDROLOGY & WATER RESOURCES ENGINEERING

Course Code:	DESIGN OF HYDRAULIC STRUCTURE	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To gain knowledge about investigation, causes of failure and design of Hydraulics structures.

COURSE OUTCOMES:

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

- Understand the knowledge on planning of Hydraulics structures.
- Students can understand the functional requirements of structures.
- Students can gain knowledge in design of Irrigation structures.
- Understand the Structures on Pervious formations.
- Understand the general features of hydro-electric schemes.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Develop knowledge on planning of Hydraulics structures..	Understand
CO2	Describe the functional requirements of structures.	Understand
CO3	Knowledge in design of Irrigation structures.	Analysis
CO4	Understand the Structures on Pervious formations.	Understand
CO5	Understand the general features of hydro-electric schemes.	Understand

Mapping of Course Outcome to Program Outcomes

Mapping of COs with Pos												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	L	S	M	S	S	M	S	S	S	L
CO2	L	M	L	S	L	M	S	L	L	S	S	L
CO3	L	M	L	S	S	L	S	M	S	S	M	S
CO4	M	M	M	L	M	L	S	M	L	M	S	S
CO5	M	M	M	S	L	S	S	M	S	L	L	M

SYLLABUS:

MODULE I

RESERVOIR PLANNING: Investigations, Capacities, Zones of storage, Mass Inflow and Mass Demand curves, Life of Reservoir.
EARTH DAMS: Types, causes of failure and design criteria, soils suitability for earth dam construction, construction methods, foundation requirements, typical earth dam sections, estimation of seepage through and below the dam, seepage control, stability of slopes by slip circle method of analysis, pore pressures, sudden draw down, steady seepage and construction pore pressure condition.

MODULE II

GRAVITY DAMS: Design Criteria, forces acting on gravity dams, elementary profile, low and high gravity dams, stability analysis, practical profile, evaluation of profile by method of zoning, foundation treatment, construction joints, galleries in gravity dams.

MODULE III

SPILLWAYS: Ogee spillway and its design, details of syphon, shaft, chute and side channel spillways, emergency spillways. Design of outlets and rating curves
ENERGY DISSIPATERS: Principles of energy dissipation Energy dissipators based on tail water rating curve and jump height curves Spillway crest gates - vertical lift and radial gates, their design principles. Design of canal regulating structures, Design of Channel transitions, Design of Sarda type Falls, Design of cross drainage works viz Syphon aquaduct and Canal syphon.

MODULE IV

STRUCTURES ON PERVIOUS FORMATIONS: Bligh's creep theory, limitations, Khoslas's theory of independent variable, Khosla's corrections, Design of Weir and Barrages :design of waterways and crest levels, design of impervious floors and protection works.

MODULE V

CANAL STRUCTURES AND HYDROPOWER PLANTS: Design of canal falls, Regulators, Cross drainage works, Introduction of Hydropower development, general features of hydro-electric schemes, selection of turbines.

LEARNING RESOURCES:

References:

1. Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds
2. Hydroelectric Hand Book by Creager
3. Hydraulic Structures by Varshney
4. Irrigation & Water Power Engg. by Punmia & Pandey B.B.Lal
5. Water Power Engineering by Dandekar

Course Code:	GROUNDWATER ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To introduce the student to the principles of Groundwater governing Equations
- To understand the characteristics of different aquifers,
- To understand the techniques of development and management of groundwater.

COURSE OUTCOMES:

- An understanding aquifer properties and its dynamics
- An exposure towards well design and practical problems
- An ability to develop a model for groundwater management.
- An ability to understand the importance of artificial recharge and groundwater quality concepts
- An ability to gain knowledge on conservation of groundwater.

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

COS NO.	Course Outcomes	Bloom's level
CO1	An understanding aquifer properties and its dynamics	Understand
CO2	An exposure towards well design and practical problems	Analysis
CO3	An ability to develop a model for groundwater management	Apply
CO4	An ability to understand the importance of artificial recharge and groundwater quality concepts	Remember
CO5	An ability to gain knowledge on conservation of groundwater	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	-	-	L	S	M	L	L	M	S	S
CO2	M	M	M	L	L	M	M	M	L	M	S	M

CO3	L	L	L	M	-	L	L	L	M	M	S	S
CO4	L	-	-	L	-	S	S	M	L	M	S	M
CO5	L	-	-	L	-	S	S	M	L	M	S	M

SYLLABUS:

MODULE I

HYDROGEOLOGICAL PARAMETERS

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms.

MODULE II

WELL HYDRAULICS

Objectives of Groundwater hydraulics – Darcy's Law - Groundwater equation – steady state flow - Dupuit Forchheimer assumption - Unsteady state flow - Theis method - Jacob method -Slug tests - Image well theory – Partial penetrations of wells.

MODULE III

GROUNDWATER MANAGEMENT

Need for Management Model – Database for groundwater management –groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery.

MODULE IV

GROUNDWATER QUALITY

Ground water chemistry - Origin, movement and quality - Water quality standards – Health and aesthetic aspects of water quality - Saline intrusion – Environmental concern and Regulatory requirements

MODULE V

GROUNDWATER CONSERVATION

Artificial recharge techniques – Remediation of Saline intrusion– Ground water management studies – Protection zone delineation, Contamination source inventory, remediation schemes- Ground water Pollution and legislation.

LEARNING RESOURCES:

Text Books:

1. Raghunath H.M., Ground Water Hydrology, New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., Ground Water Hydrology, John Wiley and Sons, New York, 2000.

References:

1. Fitts R Charles. Groundwater Science. Elsevier, Academic Press, 2002.
2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.

Course Code:	SURFACE WATER HYDROLOGY	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand the relevance of various components of hydrologic cycle,
- To understand about spatial and temporal distribution of water availability in any region.
- To understand about the measurement of stream flow
- To understand about evaporation and filtration
- To understand about unit hydrograph

COURSE OUTCOMES:

- A basic ability to obtain the complete knowledge on hydrologic cycle, hydrometeorology and formation of precipitation.
- An ability to know the various methods of rainwater and runoff harvesting. Then apply the knowledge of soil erosion and sedimentation to estimate the life of the reservoir and Spatial analysis using GIS
- A basic ability to apply the various methods of field measurements and empirical formulas for estimating the various losses of precipitation, stream flow and runoff.
- A basic ability to know the evaporation, infiltrations and Infiltration Indices.
- An ability to know the various methods of unit hydrograph

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

COS NO.	Course Outcomes	Bloom's level
CO1	A basic ability to obtain the complete knowledge on hydrologic cycle, hydrometeorology and formation of precipitation.	Understand
CO2	An ability to know the various methods of rainwater and runoff harvesting. Then apply the knowledge of soil erosion and sedimentation to estimate the life of the reservoir and Spatial analysis using GIS	Analysis
CO3	A basic ability to apply the various methods of field measurements and empirical formulas for estimating the various	Apply

	losses of precipitation, stream flow and runoff.	
CO4	A basic ability to know the evaporation, infiltrations and Infiltration Indices	Remember
CO5	An ability to know the various methods of unit hydrograph	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	---	---	L	S	M	L	L	M	S	S
CO2	L	M	M	L	L	M	M	M	L	M	S	M
CO3	L	L	L	M	---	L	L	L	M	M	S	S
CO4	L	M	---	L	---	S	S	M	L	M	S	M
CO5	L	M	L	L	---	M	M	L	L	L	M	M

SYLLABUS:

MODULE I

HYDROMETEOROLOGY

Hydrologic cycle – Global water budget – Practical applications – Hydrometeorology – Constituents of atmosphere – Vertical structure of the atmosphere – general circulation – Transitory system – Air mass – Air front – cyclones – Formation of precipitation – Types and forms of precipitation – Climate and Weather – Meteorological Observations.

MODULE II

PRECIPITATION

Measurement of rainfall – Rain gauges – Radar Measurement of rainfall - Rainfall Hyetograph – Intensity Duration and Frequency analysis – Consistency – Missing data – Rain gauge network – Average depth of rainfall analysis – Spatial analysis using GIS – Annual rainfall of India and Tamilnadu

MODULE III

ABSTRACTIONS

Water losses - Initial losses – Interception and depression storage – Evaporation – Evaporimeters – Estimation of Evaporation - Evapotranspiration – Field Measurement – Empirical Equations - Infiltration – Infiltrometers – Infiltration Equations - Infiltration Indices.

MODULE IV

STREAMFLOW MEASUREMENT

Stage and Velocity Measurement – Gauges – Current meter and Doppler flow velocity meter - Discharge measurement – Area Velocity method - Area Slope method – Discharge Measuring Structures - Dilution Technique – Stage Discharge relationship – Selection of a Stream Gauging Site.

MODULE V

RUNOFF AND WATER CONSERVATION

Concept of catchment – Linear, Areal and Relief Aspects – Detailed study of Runoff process – Factors affecting Runoff – Hydrograph – Unit Hydrograph – Synthetic Hydrograph –Runoff estimation - Strange and SCS methods – Water Conservation – Rain water and Runoff Harvesting in Rural and Urban Areas - Reservoir Sedimentation.

LEARNING RESOURCES:

Text Books:

1. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 1995.

2. Subramanya K., "Hydrology,Tata McGraw Hill Co., New Delhi, 1994.

References:

1. Patra.K.C, "Hydrology and Water Resources Engineering", Narosa Publications, 2008, 2 nd Edition, New Delhi.

2. Jeya Rami Reddy.P, "Hydrology, Laximi Publications, New Delhi, 2004

PROFESSIONAL ELECTIVE COURSE – V

(Structural Engineering)

A. Wood Structures
B. Masonry Structures
C. Structural Analysis by Matrix Methods
D. Pre stressed Concrete
E. Industrial Structures
F. Earthquake Engineering

PEC – V STRUCTURAL ENGINEERING

Course Code:	WOOD STRUCTURES	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	1	0	4	SEE Marks **60**

COURSE OBJECTIVES:

- The purpose of this course is to develop an in-depth knowledge
- design of wood structure with the latest code of practice as per the Indian Standard

COURSE OUTCOMES:

- Mechanical properties of wood and grades
- Structurally glued timbers and Design of beams and columns
- Connections of beam and columns Functional requirements for service like Wood, timber, plywood
- Behaviour and design of cconnections wood beams and columns
- Structural applications of wood

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

COS NO.	Course Outcomes	Bloom's level
CO1	Mechanical properties of wood, stress grades and working stresses	Develop
CO2	Functional requirements for service like Wood, timber, plywood	Describe
CO3	Behavior And Design Of Connections wood beams	Design
CO4	Preliminary design of buildings and design of bridges.	Design
CO5	Structural applications of wood	Applications

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	L	-	-	L	-	-	-	M	-	-
CO2	M	S	-	-	-	-	-	-	-	-	L	L
CO3	S	-	S	-	-	-	-	-	-	-	-	-
CO4	S	S	-	M	-	M	-	-	-	-	-	-
CO5	S	S	-	-	S	L	M	-	M	S	-	-

SYLLABUS:

MODULE I

PROPERTIES OF WOOD STRUCTURES AND TIMBER GRADES

Introduction, Design Specification, Methods of Grading Structural Lumber, In-Grade Versus Clear Wood Design Values,Species and Species Groups, Cellular Makeup, Moisture Content and Shrinkage, Effect of Moisture Content on Lumber Sizes,Durability of Wood and the Need for Pressure Treatment, Growth Characteristics of Wood, Sizes of Structural tIMBER, Size Categories and Commercial Grades, General Notation, Wet Service Factor CM, Load Duration Factor CD (ASD Only), Time Effect Factor (LRFD Only), Size Factor CF, Repetitive Member Factor Cr, Flat Use Factor Cfu, Temperature Factor Ct, Incising Factor Ci, Resistance Factor (LRFD Only), Format Conversion Factor KF (LRFD Only), Adjusted Design Values, Future Directions in Wood Design.Design problems.

MODULE II

STRUCTURAL GLUED LAMINATED TIMBER AND WOODEN BEAMS

Introduction, Sizes of Glulam Members,Resawn Glulam,Fabrication of Glulams ,Grades of Glulam Members, Adjustment Factors for Glulam,Design Problem: Adjusted Design Values Glulam Beam with Full Lateral Support,Design Problem: Glulam Beam with Lateral Support at 2.50M ,Design Problem: Glulam Beam with Lateral Support at 14.00M, Glulam with Compression Zone Stressed in Tension ,Cantilever Beam Systems,Lumber Roof and Floor Decking,Fabricated Wood Components

Beam Design, Introduction,Bending,Lateral Stability,Adjusted Bending Design Value Summary,Shear,Deflection,Design Summary,Bearing at Supports,(Design Problem:) Sawn Beam,(Design Problem): Rough-Sawn Beam Using ASD,(Design Problem:) Notched Beam,(Design Problem: Sawn-Beam Analysis,Design Problem:

MODULE III

AXIAL FORCES AND COMBINED BENDING AND AXIAL FORCES: Introduction,Axial Tension Members,Design Problem: Tension Member,Columns ,Detailed Analysis of Slenderness Ratio,

(Design Problem): Axially Loaded Column,Design Problem: Capacity of a Glulam Column ,Design Problem: Capacity of a Bearing Wall,Built-Up Columns ,Combined Bending and Tension,Design Problem: Combined Bending and Tension,Combined Bending and Compression,Design Problem:

Beam-Column ,Design Problem: Beam-Column Action in a Stud Wall Using LRFD,Design Problem: Glulam Beam-Column Using ASD,Design for Minimum Eccentricity,Design Problem: Column with Eccentric Load Using ASD

MODULE IV

WOOD STRUCTURAL PANELS:

Introduction,Panel Dimensions and Installation Recommendations, Plywood Makeup,Species Groups for Plywood,Veneer Grades,Exposure Durability Classifications,Plywood Grades, Other Wood Structural Panels, Roof Sheathing,Design Problem: Roof Sheathing, Floor Sheathing, Design Problem: Floor Sheathing,Wall Sheathing and Siding,Stress Calculations for Wood Structural Panels

MODULE V

WOOD CONNECTIONS

Background,Introduction,Types of Fasteners and Connections, Yield Model for Laterally Loaded Fasteners,Factors Affecting Strength in Yield Model,Dowel Bearing Strength,Plastic Hinge in Fastener,Yield Limit Mechanisms,Nailed and Stapled Connections,Types of NailsPower-Driven Nails and Staples,Yield Limit Equations for Nails,Applications of Yield Limit Equations,Adjustment Factors for Laterally Loaded Nails ,Nail Connection for Knee Brace,Top Plate Splice, Shearwall Chord Tie, Design Laterally Loaded Toenail, Laterally Loaded Connection in End Grain,Nail Withdrawal Connections, Combined Lateral and Withdrawal Loads,Spacing Requirements,Nailing Schedule,Bolts, Lag Bolts, and Other Connectors,Bolt Connections,Bolt Yield Limit Equations for Single Shear ,Bolt Yield Limit Equations for Double Shear,Adjustment Factors for Bolts,Tension and Shear Stresses at a Multiple Fastener Connection,Design Multiple-Bolt Tension Connection,Bolted Chord Splice for Diaphragm Shear Stresses in a Beam at a Connection,Bolt Connection for Diagonal Brace,Lag Bolt Connections,Yield Limit Equations for Lag Bolts

LEARNING RESOURCES:

Text Books:

1.. Design of wood structures by Donald E. Breyer, P.E.Kelly E. Cobeen, S.E.Zeno Martin, S.E.

2. Building construction by B.C Punimia

References:

1. Wood Handbook – Wood as an Engineering Material

2. Course Notes on Modern Developments in the Design and Construction of Wood Structures, Structural Engineering Research Centre, Madras, 1982.

3. Koncz,J., Manual of Precast Construction Vol. I and II, Bauverlay GMBH,1971

Course Code:	DESIGN OF MASONRY STRUCTURES	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- Know about 'Masonry', its use, advantages and disadvantages
- Have clear knowledge of different types of 'Masonry units', types and grades of 'Mortar' as per IS Code, properties of masonry units and mortar.
- 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'.
- Design different types of masonry structures selecting suitable masonry units and mortar using IS 1905 (revised in 2002) and SP 20.
- Know about the use of (i) Reinforced Masonry, (ii) Composite Masonry (iii) Confined Masonry and (iv) 'In filled frames', their advantages and disadvantages

COURSE OUTCOMES:

- Develop knowledge on planning of masonry structures.
- Describe the functional requirements of masonry structures.
- Design of different types of masonry structures
- Design Reinforce masonry wall shear wall.
- Explain the concepts of Reinforced masonry and its application

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

COS NO.	Course Outcomes	Bloom's level
CO1	Develop knowledge on planning of masonry structures.	Understand
CO2	Describe the functional requirements of masonry structures.	Understand
CO3	Design of different types of masonry structures.	Apply
CO4	Design Reinforce masonry wall shear wall.	Apply
CO5	Explain the concepts of Reinforced masonry and its application	Remember

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	-	-	M	-	S	-	-	-	-	L
CO2	-	S	-	L	-	-	M	-	S	S	-	-
CO3	-	S	-	-	-	S	-	S	S	-	S	M
CO4	-	S	S	-	S	-	-	-	-	M	-	-
CO5	-	S	-	M	-	-	-	M	L	-	L	-

SYLLABUS:

MODULE I

Brick, stone, and block masonry units – Strength, modulus of elasticity and water absorption of masonry materials- classification and properties of mortars, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking and remedial methods.

Strength and stability of concentrically loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of ageing, workmanship, strength formulae and mechanism of failure of masonry subjected to direct compression.

MODULE II

Permissible compressive stresses, 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. Codes of Practice for structural Masonry

MODULE III

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

Design for Compressive Loading, Design for Wind Loading, Lateral Load Analysis of Masonry Panels, Composite Action between Walls and Other Elements,Design for Accidental Damage

MODULE IV

Reinforced masonry and its application. Design of load bearing masonry walls for building up to 3storeys using IS 1905 and SP20 procedure. Design of Earth quake resistant walls. Design of wall joints for earthquake force.

MODULE V

Testing methods of masonry structures, Non-destructive testing and damage assessment of masonry structures, flexural and compression elements of reinforced masonry, shear walls. Composite masonry walls. Testing of walls for impact. Testing for Earth quake.

LEARNING RESOURCES:

Text books:

1. Henry,A.W (1990), “Structural masonry”, Macmillan Education Ltd.
2. Dayarathnam.P (1987), “Brick and reinforced brick structures”, Oxford & IBH Publication.

Reference:

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

Course Code:	**STRUCTURAL ANALYSIS BY MATRIX METHOD**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand the basic concepts of Matrix Methods of Structural Analysis.
- To distinguish between force method and displacement method.
- To understand the behaviour of plane trusses & plane frames.

COURSE OUTCOMES:

- Analyse the transformation of forces from element to system.
- Analyse the beams and frames by matrix flexibility method.
- Analyse the transformation of displacements from element to system.
- Analyse the beams and frames by matrix stiffness method.
- Analyse the structures by matrix displacement method.

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

COS NO.	**Course Outcomes**	**Bloom’s level**
CO1	Explain Force and Displacement measurements, Transformation of forces.	Understand
CO2	Analysis of pin-jointed frames.	Analysis
CO3	Analysis of statically indeterminate beams and rigid jointed plane frames.	Analysis
CO4	Application to space frames.	Apply
CO5	Matrix stiffness method, Application to pin-jointed plane frames.	Apply

CO6	Application to continuous beams and rigid jointed plane frames.	Apply
CO7	Analysis of three dimensional pinned frames	Analysis
CO8	Transfer matrix method for symmetric and unsymmetrical of structures.	Understand

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	M	M	M	L	M	M	M	L
CO2	S	S	S	S	M	M	L	L	S	S	L	M
CO3	S	S	M	M	M	M	L	L	-	-	L	L
CO4	S	S	S	S	S	-	-	L	S	S	M	M
CO5	S	S	S	S	M	M	M	L	S	S	M	M
CO6	M	S	S	M	M	S	S	L	S	S	M	M
CO7	L	L	S	S	M	-	-	-	M	M	-	M
CO8	S	S	S	M	M	S	S	S	S	M	S	S

SYLLABUS:

MODULE I

FUNDAMENTAL CONCEPTS

Introduction– Force and Displacement measurements– Principle of superposition–Transformation of forces–Element flexibility to system Flexibility. Matrix flexibility method– Analysis of pin-jointed frames– effects due to lack of it and temperature changes.

MODULE II

ANALYSIS OF STRUCTURES BY FLEXIBILITY METHOD

Analysis of statically indeterminate beams and rigid jointed plane frames-effect of support settlements and elastic supports.Application to space frames–Direct flexibility approach.

MODULE III

INTRODUCTION TO STIFFNESS METHOD

Matrix stiffness method–Transformation of displacements–Element stiffness to system stiffness– Application to pin-jointed plane frames– support settlements–lack of it and temperature effect

MODULE IV

ANALYSIS OF STRUCTURES BY STIFFNESS METHOD

Matrix stiffness method—Application to continuous beams and rigid jointed plane frames–effects of support settlements and elastic supports. Analysis of three dimensional pinned frames.

MODULE V

MATRIX DISPLCEMENT METHOD

Special topics-condensation, substructing-reanalysis techniques- transfer matrix method for symmetric and unsymmetrical of structures-Analysis of frames with semi rigid connections.

LEARNING RESOURCES:

Text Books:

1. C.NatarajanandRevathiP,"MatrixMethodsofStructuralAnalysis"PHIlearning PvtLtd,NewDelhi2014.
2. .PanditG.S.andGupta,S.P.,"StructuralAnalysis–AMatrixApproach",Tata McGrawHillPublishingCo.,NewDelhi,1997.
3. Rajasekaran S., and SankaraSubramaninan,G.,"Computational Structural Mechanics",PrenticeHallofIndiaPvt.Ltd.,NewDelhi,FirstEdition2001.
4. Dr.DevadasMenon., Advanced Structural Analysis, Narosa Publishing House, NewDelhi,2009.
5. ReddyC.S.,"BasicStructuralAnalysis",TataMcGraw-HillPublishingCompany Limited,NewDelhi,1997.
6. T.S.ThandavaMoorthy,"Analysis of structures", Oxford University Press,
7. Pandit G.S., & Gupta S.P. (1998), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.

References:

1. J.S.Przemieniecki (1995), Theory of Matrix structural Analysis, McGraw-Hill,
2. Meek,J.L. (1997), Matrix Structural Analysis.
3. Kanchi (1995), Matrix Structural Analysis, Wiley Eastern Ltd., New Delhi.

Course Code:	**PRESTRESSED CONCRETE STRUCTURES**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PCC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand the behaviour and performance of pre-stressed concrete structures.
- Compare the behaviour of pre-stressed concrete members with that of the normal reinforced concrete structures.
- Understand the performance of composite members. Finally to learn the design of prestressed concrete structures.

COURSE OUTCOMES:

- Design a pre-stressed concrete beam accounting for losses.
- Design for flexure and shear.
- Design the anchorage zone for post tensioned members and deflection in beams.
- Design composite members and continuous beams.
- Design water tanks, pipes and poles.

COS NO.	Course Outcomes	Bloom's level
CO1	Design a pre-stressed concrete beam accounting for losses.	Design & analysis
CO2	Design for flexure and shear.	Design & analysis
CO3	Design the anchorage zone for post tensioned members and deflection in beams.	Design & analysis
CO4	Design composite members and continuous beams.	Design & analysis
CO5	Design water tanks, pipes and poles.	Design & analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	-	-	M	-	-	L	L		L
CO2	M	M	L	-	-	L	-	-	L	L	-	L
CO3	M	L	M	-	-	L	-	-	L	L	-	L
CO4	M	L	M	-	-	L	-	-	L	L	-	L
CO5	M	M	M	-	-	L	-	-	L	L	-	L

SYLLABUS:

MODULE I

INTRODUCTION:

Historical developments – Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Magnel, Gifford Udall anchorage systems – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Losses of prestress in post -tensioned members.

MODULE II

DESIGN FOR FLEXUREAND SHEAR:

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per I.S.1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength limit based on I.S. 1343 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

MODULE III

DEFLECTION AND DESIGN OFANCHORAGEZONE:

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and I.S. 1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

MODULE IV

COMPOSITE BEAMS ANDCONTINUOUS BEAMS:

Analysis and design of T-Beam and composite beams - Shrinkage strain and its importance – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

MODULE V

MISCELANEOUS STRUCTURES:

Design of tension and compression members – Design of sleepers, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

LEARNING RESOURCES:

Text Books:

1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, fifth edition, 2012.
2. Pandit.G.S. and Gupta.S.P. Prestressed Concrete, CBS Publishers and Distributers Pvt. Ltd., Second edition, 2014.

References:

1. Lin T.Y. and Ned.H.Burns, Design of prestressed Concrete Structures, John Wiley and Sons, Third Edition,1981.
2. Rajagopalan.N, Prestressed Concrete, Narosa Publishing House, 2002.
3. Dayaratnam.P. Sarah P, Prestressed Concrete Structures, Seventh Edition, Oxford and IBH, 2017.
4. Sinha.N.C. AndRoy.S.K. Fundamentals of Prestressed Concrete, S.Chand and Co. Ltd., 2011.

Course Code:	**INDUSTRIAL STRUCTURES**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To gain knowledge about analyze, design and detailing of industrial structures.

COURSE OUTCOMES:

- Understand the knowledge on planning of Industrial structures.
- Students can understand the functional requirements of structures.
- Analyze and design of steel structure in industrial building.
- Analyze and design of R.C.C structure in industrial structures.
- Understand the basic concept of Industrial prefabrication.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Develop knowledge on planning of industrial structures.	Understand
CO2	Describe the functional requirements of structures.	Analysis
CO3	Analyze and design of steel structure in industrial building.	Analysis
CO4	Analyze and design of R.C.C structure in industrial structures.	Apply
CO5	Understand the basic concept of Industrial prefabrication.	Understand

Mapping of Course Outcome to Program Outcomes

Course Outcomes (Cos)	Mapping of COs with POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	L	-	-	M	-	-	S	S	-	M
CO2	L	M	L	-	-	S	-	-	S	S	-	S
CO3	L	M	L	-	-	L	-	-	S	S	-	M
CO4	M	M	L	-	-	S	-	-	S	S	-	M
CO5	M	M	L	-	-	S	-	-	S	S	-	S

SYLLABUS:

MODULE I

PLANNING

Classification of industries and industrial structures – General requirements of various industries Planning and layout of buildings and components.

MODULE II

FUNCTIONAL REQUIREMENTS

Requirements and design of Lighting – Requirements and design ofVentilation - Requirements and design ofAcoustics – Requirements and design of Fire safety – Guidelines from factories act.

MODULE III

DESIGN OF STEELSTRUCTURES

Requirements and design of Industrial roofs, Space structures – Requirements and design ofCrane girders

Requirements and design of pre-engineered and Mills buildings - Bunkers and Silos – pipe/cable racks - Chimney.

MODULE IV

DESIGN OF R.C.STRUCTURES

Corbels, Brackets and Nibs - Silos and bunkers – Chimney - Principles of folded plates and shell roofs.

MODULE V

PREFABRICATION

Principles of prefabrication – Pre stressed precast roof trusses - Construction of roof and floor slabs - Wall panels - Storage/transportation/handling in yard/site and erection – Joints in precast structures.

LEARNING RESOURCES:

Text books:

1. Ramamrutham.S. Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, 2007.
2. Bhavikatti.S.S. Design of Steel Structures, J.K. International Publishing House Pvt. Ltd., 2009.

References:

1. Ramachandra and VirendraGehlot, Design of steel structures -2, Scientific Publishers 2012.
2. Varghese.P.C. Advanced Reinforced Concrete Design, PHI, Eastern Economy Editions, Second Edition, 2005.
3. Handbook on Functional Requirements of Industrial buildings, SP32–1986, Bureau of Indian Standards,1990.
4. Koncz, J., Manual of Precast Construction Vol. I and II, Bauverlay GMBH,1971.

Course Code:	EARTHQUAKE ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand the concept of seismology.
- To know the basic principles of structural dynamics.
- To get an idea of about the applications of structural dynamics in earthquake engineering.

COURSE OUTCOMES:

- Evaluate the behaviour of structures under dynamic loadings.
- Understand the concept of response of structures.
- Design of earthquake resistance structures.

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

COS NO.	Course Outcomes	Bloom's level
CO1	How the Earthquake occurs, Elements of Seismology and earthquake effects.	Understand
CO2	The Earthquake phenomenon and characteristics of earthquake ground motion and seismic instrumentation.	Understand
CO3	The science and engineering fundamentals to idealize and formulate the equations of motion for SDOF system	Apply
CO4	Explain the earthquake protective system. Seismic design methods. The earthquake resistance structures and the detailing of reinforcement for seismic resistance structures.	Remember
CO5	To determine the Earthquake load. The earthquake resistance structures and the detailing of reinforcement for seismic analysis.	Apply
CO6	The various causes and effects of earthquakes on structures. Case studies of past earthquakes.	Understand

Mapping of Course Outcome to Program Outcomes:

Course Outcomes	Mapping of COs with POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	M	M	L	L	M	M	M	L
CO2	S	S	M	S	M	M	L	L	S	S	L	M
CO3	S	M	S	S	M	M	L	L	M	S	L	L

CO4	S	S	S	S	M	M	M	L	S	S	M	M
CO5	S	M	S	S	M	M	M	L	S	S	M	M
CO6	M	S	S	M	M	S	S	L	S	S	M	M

SYLLABUS:

MODULE I

ELEMENTS OF ENGINEERING SEISMOLOGY

Elements of Engineering Seismology: Earthquake occurrence in the world, causes of earthquake, plate tectonics, earthquake mechanism, seismic zoning map of India & its use. Earthquake Effects: – On ground and soil liquefaction, buildings, structures, power plants, switch, yards, equipment's & other lifeline structures. Secondary Effects – Land and rock slides, liquefaction, fires, tsunamis, floods, release of poisonous gases and radiation.

MODULE II

EARTHQUAKR PHENOMENON

Earthquake Phenomenon: – focus, epicentre, seismic waves, magnitude, intensity, and intensity scale, characteristics of strong ground motions and attenuation, earthquake recording instruments. Dos and Don'ts for protection of life and property.

MODULE III

INTRODUCTION TO THEORY OF VIBRATIONS

Introduction to theory of vibrations: Single degree Un-damped and damped systems, elastic response to simple load functions & earthquake response spectra.

MODULE IV

INTRODUCTION TO SEISMIC DESIGN OF STRUCTURES

Introduction to seismic Design of Structures: Earthquake Resistant Design Methods- Philosophy and principles of earthquake resistance design – Strength and stiffness, ductility design and detailing (IS: 13920), concepts of seismic base isolation and seismic active control. Building forms and architectural design concepts – Horizontal and vertical eccentricities due to mass and stiffness distribution and setbacks.

MODULE V

PERFORMANCE OF BUILDING AND STRUCTURES

Equivalent static lateral earthquake force on building (IS: 1893): Equivalent static method – Seismic coefficients – evaluation, estimation of fundamental time period, base shear and its distribution,

Performance of building and Structures: Main causes of damage – Intensity of earth quake forces, lack of strength and integrity in buildings, quasi resonance, lack of ductility, lack of detailing. Lessons learnt from the past earthquakes: – Case studies of important Indian earthquakes, major world earthquakes, earthquake catalogue, and assessment of damage.

LEARNING RESOURCES:

Text Books:

1. A K. Chopra (2003), Dynamics of Structures – Theory and Applications to Earthquake Engineering, Second Edition, Printice-Hall India Pvt Ltd.
2. Paulay, T. and Priestley, M.J.N., "Seismic Design of Reinforced and Masonry Buildings", John Wiley & Sons, Inc., New York, 1992.
3. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.

References:

1. Anil K. Chopra, (1998). Dynamics of Structures, McGraw Hill International Edition.
1. Clough, R.W. and Penzien, J., (1993). Dynamics of Structures, Second Edition, McGraw Hill International Edition.
2. Arnold, C. and R. Reitherman, (1982). Building Configuration and Seismic Design, John Wiley & Sons, Inc., New York.
3. Dowrick, D.J., (1997). Earthquake Resistant Design, John Wiley & Sons, Chichester, U.K.
4. Paulay, T. and M.J.N. Priestley, (1992). Seismic Design of Reinforced and Masonry Buildings, John Wiley & Sons, Inc., New York.
5. Jaikrishna and A.R. Chandrasekaran, (1986). Elements of Earthquake Engineering, Sarita Prakashan, Meerut.
6. National Earthquake Hazard Reduction Programme (NEHRP), Guidelines for Seismic Design of Buildings, Federal Emergency Management Agency – 312, Washinton.DC, 2000.

PROFESSIONAL ELECTIVE COURSE – VI

(Environmental Engineering)

A. Ecological Engineering
B. Rural Water Supply and Onsite Sanitation Systems
C. Water and Air Quality Modeling
D. Solid and Hazardous Waste Management
E. Air and Noise Pollution and Control
F. Environmental Impact Assessment and Life Cycle Analyses

PEC – IV ENVIRONMENTAL ENGINEERING

Course Code:	ECOLOGICAL ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To develop a basic knowledge about the ecological engineering and apply the same in the field application.
- To educate the students on the principles of ecology as applied to environmental engineering.

COURSE OUTCOMES:

- Identify the principles and concepts pertaining to communities in ecosystem
- An ability to know principles and ecological models
- Determine the concept of ecosystem
- An ability to know the application of ecological engineering
- An ability to know the case studies in ecological engineering

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

COS NO.	Course Outcomes	Bloom's level
CO1	Identify the principles and concepts pertaining to communities in ecosystem	Understand
CO2	An ability to know principles and ecological models	Analysis
CO3	Determine the concept of ecosystem	Apply
CO4	An ability to know the application of ecological engineering	Remember
CO5	An ability to know the case studies in ecological engineering	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
Cos /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	M	L	L	-	-	S	M	S	L
CO2	S	L	L	M	L	L	L	L	S	M	S	M
CO3	S	L	L	M	L	L	M	L	M	M	S	L
CO4	S	L	L	M	L	L	L	L	S	M	S	M
CO5	S	L	L	M	L	L	M	L	S	S	M	M

SYLLABUS:

MODULE I

ECOLOGY & ENVIRONMENT

Aim, scope and applications of ecology - Development and evolution of ecosystems - Principles and concepts pertaining to communities in ecosystem - Energy flow and material cycling in ecosystems - productivity in ecosystems - Rationale of ecological engineering and ecotechnology - Classification of ecotechnology

MODULE II

PRINCIPLES OF ECOLOGICAL ENGINEERING.

Principles, components and characteristics of Systems - Classification of systems - Structural and functional interactions of environmental systems - Environmental systems as energy systems - Mechanisms of steady-state maintenance in open and closed systems - Modelling and ecotechnology - Elements of modelling - Modelling procedure - Classification of ecological models - Applications of models in ecotechnology - Ecological economics.

MODULE III

CONCEPT OF ECOSYSTEM

Self-organizing design and processes - Multiple seeded microcosms - Interface coupling in ecological systems - Concept of energy - Determination of sustainable loading of ecosystems.

MODULE IV

APPLICATION OF ECOLOGICAL ENGINEERING

Ecosanitation - Principles and operation of soil infiltration systems - Wetlands and ponds - Source separation systems - Aquacultural systems - Detritus based treatment for solid wastes - Applications of ecological engineering for marine systems.

MODULE V

CASE STUDIES IN ECOLOGICAL ENGINEERING

Case studies of Integrated Ecological Engineering Systems and their commercial prospects.

LEARNING RESOURCES:

Text Books:

1. Kangas, P.C. and Kangas, P., *"Ecological Engineering: Principles and Practice", Lewis Publishers, New York. 2003.*
2. Etnier, C. and Guterstam, B., *"Ecological Engineering for Wastewater Treatment",* Lewis Publishers, New York. 2007.
3. Kangas, P.C. and Kangas, P., *"Ecological Engineering: Principles and Practice",*

References:

1. Lewis Publishers, New York. 2003.
2. Etnier, C. and Guterstam, B., "Ecological Engineering for Wastewater Treatment", Lewis Publishers, New York. 2007.
3. White, I.D., Mottershed, D.N. and Harrison, S.J., "Environmental Systems - An Introductory Text", Chapman Hall, London. 2004.
4. Mitsch, J.W. and Jorgensen, S.E., "Ecological Engineering - An Introduction to Ecotechnology", John Wiley & Sons, New York. 2009.

Course Code:	RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEMS	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To understand the monitoring and surveillance, operation and maintenance of rural water supplies
- To understand about low Cost Water Treatment
- To understand about Rural Sanitation
- To understand about industrial Hygiene And Sanitation, Solid Waste Management

COURSE OUTCOMES:

- Identify the problems pertaining to rural water supply and sanitation.
- Design water supply and sanitation system for rural community
- Design low cost waste management systems for rural areas
- An ability to Industrial plant sanitation
- Plan and design an effluent disposal mechanism.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Identify the problems pertaining to rural water supply and sanitation.	Understand
CO2	Design water supply and sanitation system for rural community	Analysis
CO3	Design low cost waste management systems for rural areas	Apply
CO4	An ability to about Industrial plant sanitation	Remember
CO5	Plan and design an effluent disposal mechanism.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	M	L	L	-	-	S	M	S	L
CO2	S	L	L	M	L	L	L	L	S	M	S	M
CO3	S	L	L	M	L	L	M	L	M	M	S	L
CO4	S	L	L	M	L	L	L	L	S	M	S	M
CO5	S	L	L	M	L	L	M	L	S	S	M	M

SYLLABUS:

MODULE I

Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply- merits- National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies

MODULE II

Low Cost Water Treatment: Introduction – Epidemiological aspects of water quality- methods for low cost water treatment - Specific contaminant removal systems

MODULE III

Rural Sanitation: Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas- stabilization ponds - septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems- Effluent disposal.

MODULE IV

Industrial Hygiene And Sanitation: Occupational Hazards- Schools- Public Buildings- Hospitals- Eating establishments- Swimming pools – Cleanliness and maintenance and comfort- Industrial plant sanitation.

MODULE V

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling- incineration- Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.

LEARNING RESOURCES:

Text Books:

1. Eulers, V.M., and Steel, E.W., Municipal and Rural Sanitation, 6th Ed., McGraw Hill Book Company, 1965
2. Park, J.E., and Park, K., Text Book of Preventive and Social Medicine, Banarsidas Bhanot, 1972

References:

1. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing Company, Huntington, New York, 1977
2. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007

Course Code:	WATER & AIR QUALITY MODELING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To develop a basic knowledge about the concept of air and water quality modelling and apply the same in the field application
- To understand about preparation of networks.
- To educate the students on the basic principles, development and application of air and water quality models with computer applications.
- To understand about Water quality standards
- To understand about various computer models for surface water quality, and air quality

COURSE OUTCOMES:

- An idea of a basic knowledge about the concept of air and water quality modelling
- An idea of about preparation of networks.
- An ability to know about the application of air and water quality models with computer applications.
- An ability to know about the air and water quality index
- An ability to about various computer models
  After the successful completion of the course students will be able to

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

COS NO.	Course Outcomes	Bloom's level
CO1	An idea of a basic knowledge about the concept of air and water quality modelling	Understand
CO2	An idea of about preparation of networks.	Analysis
CO3	An ability to know about the application of air and water quality models with computer applications	Apply
CO4	An ability to know about the air and water quality index	Remember
CO5	An ability to about various computer models	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	---	---	L	S	M	L	L	M	S	S

CO2	M	M	M	L	L	M	M	M	L	M	S	M
CO3	L	L	L	M	---	L	L	L	M	M	S	S
CO4	L	---	---	L	---	S	S	M	L	M	S	M
CO5	L	---	L	L	---	M	M	L	L	L	M	M

SYLLABUS:

MODULE I
WATER QUALITY MODELLING

Estuaries - estuarine transport, - estuary dispersion coefficient; Lakes and impoundments - water quality response to inputs; water quality modeling process - model sensitivity - assessing model performance.

MODULE II
FLOW ANALYSIS

Historical development of water quality models - rivers and streams water quality modelling - river hydrology and flow - low flow analysis - dispersion and mixing - flow, depth, and velocity.

MODULE III
DISPERSION OF AIR POLLUTANTS

Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - atmospheric stability - Air pollution modelling and prediction - Plume rise, modelling techniques.

MODULE IV
AIR QUALITY MODELLING

Model - definition - types - uses - systems and models - kinds of mathematical models - model development - water quality standards - ambient air quality standards.

MODULE V
SOFTWARE MODELLING

Exposure to computer models for surface water quality, and air quality.

LEARNING RESOURCES:

Text Books:

1. Rao.M.N. &RaoH.V.N., “Air Pollution”, Tata McGraw Hill,2006.
2. Richard W. Boubel, Donald L. Fox, D. Bruce Turner & Arthur C. Stern, “Fundamentals of Air Pollution, Hardcover”, 2007.
3. Kenneth Wark, Cecil F. Warn,“Air pollution its origin and control”, 2007.

References:

1. StevenC.Chapra, "Surface Water quality modeling", The McGraw-Hill- Companies Inc., New York, 1997.
2. John Wainwright and Mark Mulligan, “Environmental Modelling Finding Simplicity in Complexity”, John Wiley and sons Ltd, USA, 2004.
3. Deaton and Wine brake, “Dynamic Modeling of Environmental Systems”, Wiley & sons, 2002.

Course Code:	**SOLID AND HAZARDOUS WASTE MANAGEMENT**	**L**	**T**	**P**	**Credit**	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To impart knowledge and skills relevant to minimization, storage, collection, transport, recycling, processing and disposal of solid and hazardous wastes.
- To know the related regulations, engineering principles, design criteria, methods and equipment for solid and hazardous wastes.

COURSE OUTCOMES:

- To know the sources and legislations on management and handling of solid and hazardous waste management including the associated legal, health, safety, and cultural issues as well as responsibilities of different stakeholders.
- Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes
- An ability to know the waste collection, transport and material recovery
- Select appropriate methods for treatment of solid and hazardous wastes and convert into useful by-products,
- Select appropriate methods for disposal of solid and hazardous wastes, taking into account the impact in a sustainable environment.

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

COS NO.	**Course Outcomes**	**Bloom’s level**
CO1	To know the sources and legislations on management and handling of solid and hazardous waste management.	Understand
CO2	To Apply the knowledge of different types of solid and hazardous wastes.	Analysis
CO3	Design of systems and processes to meet specified needs of waste minimization, storage, collection, transport, recycling, processing and disposal.	Apply
CO4	Select appropriate methods for treatment of solid and hazardous wastes and convert into useful by-products.	Remember
CO5	Select appropriate methods for disposal of solid and hazardous wastes, taking into account the impact in a sustainable environment.	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	S	-	-	-	L	S	-	-	M	-	-
CO2	S	-	M	-	M	M	S	-	-	M	-	M
CO3	-	-	S	-	M	M	M	-	-	M	-	M
CO4	-	S	-	-	S	-	M	-	-	M	-	M
CO5	-	-	S	-	M	-	M	-	-	M	-	L

SYLLABUS:

MODULE I
WASTE CLASSIFICATION AND REGULATIONS

Sources and types of solid and hazardous wastes - need for solid and hazardous waste management – salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries – elements of integrated waste management and roles of stakeholders - seven elements and seven step approach to integrated solid waste management planning.

MODULE II
WASTE CHARACTERIZATION, SOURCE REDUCTION AND RECYCLING

Waste sampling and characterization plan - waste generation rates and variation – physical composition, chemical and biological properties – hazardous characteristics – ignitability, corrosivity and TCLP tests – source reduction, segregation and onsite storage of wastes – waste exchange - extended producer responsibility - recycling of plastics, C&D wastes and E wastes.

MODULE III
WASTE COLLECTION, TRANSPORT AND MATERIAL RECOVERY

collection system, labelling and handling of hazardous wastes – - principles and design of transfer and transport facilities - mechanical processing and material separation technologies – Size reduction – size separation - density separation - magnetic separation – compaction – principles and design of material recovery facilities – physico chemical treatment of hazardous wastes - solidification and stabilization – case studies on waste collection and material recovery

MODULE IV
BIOLOGICAL AND THERMAL TREATMENT

Biological and thermo chemical conversion technologies – composting – biomethanation – incineration – pyrolysis- plasma arc gasification –principles and design of biological and thermal treatment facilities - MSW processes to energy with high-value products and specialty by-products - operation of facilities and environmental controls - treatment of biomedical wastes – case studies and emerging waste processing technologies.

MODULE V

WASTE DISPOSAL

Sanitary and secure landfills - components and configuration– site selection - liner and cover systems - geo synthetic clay liners and geo membranes - design of sanitary landfills and secure landfills- leachate collection, treatment and landfill gas management – landfill construction and operational controls - landfill closure and environmental monitoring – landfill bioreactors – rehabilitation of open dumps and bio mining of dumpsites-remediation of contaminated sites- Case studies

LEARNING RESOURCES:

Text Books:

1. William A. Worrell, P. AarneVesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.
2. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
3. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010

References:

1. CPHEEO, “Manual on Municipal Solid waste management, Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
3. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.
4. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018
5. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management – Science and Engineering , Butterworth-Heinemann, 2016

Course Code:	AIR POLLUTION AND CONTROL ENGINEERING	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

Objective of the course

- To identify the major sources and sinks of air pollutants.
- To understand the key chemical transformations of air pollution.
- To relate air pollution regulation and its scientific basis.
- To describe engineering solutions to air pollution problems.

Course Outcome:

The students completing the course will have

- An understanding of the nature and characteristics of air pollutants and basic concepts of air quality management
- An ability to design stacks and particulate air pollution control devices to meet applicable standards.
- An ability to select control equipments.
- An ability to ensure quality, control and preventive measures.
- An ability to identify, formulate and solve air and noise pollution problems

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

COS NO.	Course Outcomes	Bloom's level
CO1	An understanding of the nature and characteristics of air pollutants and basic concepts of air quality management	Understand
CO2	An ability to design stacks and particulate air pollution control devices to meet applicable standards.	Analysis
CO3	An ability to select control equipments.	Apply
CO4	An ability to ensure quality, control and preventive measures.	Remember
CO5	An ability to identify, formulate and solve air and noise pollution problems	Apply

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	S	-	S	-	S	-	-	-	-	-
CO2	L	L	M	L	S	-	M	S	-	-	-	-

CO3	L	L	M	L	S	-	M	M	-	-	-	-
CO4	L	L	M	L	S	-	M	M	-	-	-	-
CO5	L	L	M	L	S	-	M	M	-	-	-	-

SYLLABUS:

MODULE I INTRODUCTION

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution– Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

MODULE II METEOROLOGY

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

MODULE III CONTROL OF PARTICULATE CONTAMINANTS

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

MODULE IV CONTROL OF GASEOUS CONTAMINANTS

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters –Process control and Monitoring - Operational Considerations.

MODULE INDOOR AIR QUALITY MANAGEMENT

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control- Sources and Effects of Noise Pollution – Measurement – Standards – Control and Preventive measures.

LEARNING RESOURCES:
Text Books:

1. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
3. Anjaneyulu. Y, 'Air Pollution and Control Technologies'Allied Publishers (P) Ltd.,India 2002

References:

1. David H.F. Liu, Bela G. Liptak 'Air Pollution', Lweis Publishers, 2000.
2. Arthur C.Stern, 'Air Pollution (Vol.I – Vol.VIII)', Academic Press, 2006.
3. Wayne T.Davis, 'Air Pollution Engineering Manual', John Wiley & Sons, Inc.,2000.

Course Code:	ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS	L	T	P	Credit	CIA Marks **40**
Course Category: PEC		3	0	0	3	SEE Marks **60**

COURSE OBJECTIVES:

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
- To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

COURSE OUTCOMES:

- Identify environmental attributes for the EIA study.
- Identify methodology and prepare EIA reports.
- Specify methods for prediction of the impacts.
- Formulate environmental management plans.
- An ability to know about the legal requirements of Environmental and Risk Assessment for projects.

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

COS NO.	Course Outcomes	Bloom's level
CO1	Identify environmental attributes for the EIA study	Understand
CO2	Identify methodology and prepare EIA reports.	Analysis
CO3	Specify methods for prediction of the impacts.	Apply
CO4	Formulate environmental management plans.	Remember
CO5	An ability to know about the legal requirements of Environmental and Risk Assessment for projects.	Analysis

Mapping of Course Outcome to Program Outcomes:

Mapping of COs with POs												
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	M	S	-	M	-	L	-	L
CO2	S	M	L	L	L	S	-	M	-	-	-	L
CO3	S	M	M	S	L	S	-	M	L	-	-	-
CO4	S	M	M	M	M	M	M	M	-	-	L	-
CO5	S	M	M	M	M	S	-	M	-	-	L	-

SYLLABUS:

MODULE I

EVOLUTION, RAPID AND COMPREHENSIVE EIA

Concepts – Methodologies – Screening- Scoping- Base line studies- Mitigation – Matrices - Check List. Legislative and Environmental Clearance procedures in India - Predication tools for EIA.

MODULE II

ASSESSMENT OF IMPACTS AND SOCIO CULTURAL ENVIRONMENT

Air - Water - Soil - Noise - Biological, Public participation - resettlement and rehabilitation.

MODULE III

DOCUMENTATION OF EIA

Environmental management Plan - Post Project monitoring- Environmental Audit- Life cycle Assessment - EMS - case studies in EIA.

MODULEI

INTRODUCTION TO LCA

Inventory analysis, Impact assessment, Ecological risk and human risk, Eco-system impacts and un-certainty analysis

MODULE V

CASE-STUDIES OF LCA

Applications of LCA, Case-studies of product LCA, Case studies of process LCA, Limitations of LCA, LCA project study

LEARNING RESOURCES:

Text Books:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996

2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003

3. World Bank –Source book on EIA

4. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.

5. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw

References:

1. Raghavan K. V. and Khan A A. , Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.
2. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
3. Ciambrone , D.F., Environmental Life Cycle Analysis, CRC Press, 1997
4. Handbook on Life Cycle Assessment : Operational guide to the ISO standards, Kluwer Academic Publishers, 2004, Hill Inc., New York,1996.

Sri Chandrasekharendra Saraswathi Viswa Maha Vidyalaya

HUMBLE PRANAMS

Education is Empowerment

"Education is the best friend. An educated person is respected everywhere" - Chanakya

SCSVMV strongly believes that nothing is as powerful as an informed mind and no quest is greater than a quest for knowledge. University always strives to give the finest education possible with a strong emphasis on value system. SCSVMV students are not just academic achievers but self-reliant individuals who have the values and vision to transform our great nation.

SCSVMV – A Brief History

The Viswa Mahavidyalaya was established in 1993 with the benign Blessings of their Holiness Pujyasri Jayendra Saraswathi Swamiji and Pujyasri Sankara Vijayendra Saraswathi Swamiji. It was formed under the aegis of Sri Kanchi Kamakoti Peetam Charitable Trust.

Location

Kanchipuram is located about 60 km from Chennai and is well connected by road, rail and air. SCSVMV is located at Enathur, 3.5 km from Kanchipuram.

Graduate Programmes

B.E. (Full Time)
Civil / Civil & Structural Engineering / CSE / ECE/ EEE / EIE
Mechanical / Mechatronics
B.Tech (Full Time / Lateral entry)
Information Technology
B.E. (Lateral Entry)
Civil / Civil & Structural Engineering / CSE / ECE/ EEE / EIE
Mechanical / Mechatronics
B.E. (Part Time)
EEE / Mech / Civil
B.A.M.S.
B.Sc.
Computer Science / Physics / Chemistry / Mathematics
B.Com / B.B.A. / B.C.A.
B.A
Sanskrit / English / Tamil
B.Ed.

Post Graduate Programmes

M.E. (Full Time / Part Time)
CSE / Thermal Engg. / Engg. Design / Power Systems
Electronics & Control/ Embedded System Technologies
M.B.A. (Full Time)
Finance / Marketing / HR / Systems / Operations
Logistics / Banking
M.D/ M.S (Ayurveda)
KC/PK/PTSR/RSBK/SHALYA
M.C.A. (Regular / Lateral Entry)
M.Sc.
Mathematics / Physics / Chemistry
M.A.
Sanskrit / English / Tamil
M.Com.

Research Programmes

M.Phil (Full Time)
Education / English / Physics
Mathematics / Chemistry / Computer Science / Sanskrit
Ph.D (Full time / Part time)

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