DELHI TECHNOLOGICAL UNIVERSITY

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

FOR

B. Tech. (CIVIL ENGINEERING)

Semester	I	Examination	November,	2009
Semester	II	Examination	May,	2010
Semester	III	Examination	November,	2010
Semester	IV	Examination	May,	2011
Semester	V	Examination	November,	2011
Semester	VI	Examination	May,	2012
Semester	VII	Examination	November,	2012
Semester	VIII	Examination	May,	2013

Syllabus applicable to the students seeking admission to the B.Tech. (Civil Engineering) Course in the academic year 2009-10.

DEPARTMENT OF CIVIL ENGINEERING

Summary of Revised Scheme of Examination

Total Credits for B.Tech. degree: 240
Semester wise : I- , II- , III- , IV- , V- , VI- , VII- , VIII-
Classification of Credits in each semester:

Semester	Credits – H	Credits – A	Credits – C	Credits – M	Total Credits
I	14	16	00	00	30
II	19	11	00	00	30
III	12	02	16	00	30
IV	00	07+02*	21+02*	00	30
V	00	00	28	02	30
VI	00	00	30	00	30
VII	00	00	22	08	30
VIII	07*	07*	11	12	30
Total Credits 240	52/45	45/36	130/128	22	240
Percentage Contents of H, A, C	21.67/18.75	18.75/15.00	54.17/53.33	09.17	100.00

*The credits are for one subject only that can be offered (or chosen by student) either by Humanities or Other Engineering Departments.

H Humanities, Social Studies and Basic Sciences
A Allied Engineering
C Core (include major project and practical training also)
M Mandatory Core

Industrial training of 08 weeks durations during summer vacations after 6th semester and 08 weeks after 7th semester during winter vacation.

DELHI TECHNOLOGICAL UNIVERSITY

NEW SCHEME OF EXAMINATION

1. There shall be the following four year Degree courses under the Faculty of Technology.

   i. Bachelor of Technology (Electrical)
   ii. Bachelor of Technology (Electronics & Communication)
   iii. Bachelor of Technology (Mechanical)
   iv. Bachelor of Technology (Civil)
   v. Bachelor of Technology (Production & Industrial)
   vi. Bachelor of Technology (Polymer Science & Chemical Technology)
   vii. Bachelor of Technology (Computer)
   viii. Bachelor of Technology (Instrumentation & Control)
   ix. Bachelor of Technology (Environmental)
   x. Bachelor of Technology (Manufacturing Process & Automation)
   xi. Bachelor of Technology (Information Technology)
   xii. Bachelor of Technology (Bio Technology)

2. In addition to the conditions laid down in Ordinance I, a candidate seeking admission to any of the above Courses of study for the Bachelor"s Degree should satisfy the following conditions.

   (a) Educational Qualifications*:*

   A candidate passing any one of the following examinations and securing 60 percent or more marks in the aggregate of Physics, chemistry And Mathematics shall be eligible for admission to the first Semester of Bachelor of Engineering Course provided he/she has passed in each subject separately ;

   i. Senior Schools Certificate Examination (12 year course) of the Central Board of Secondary Education (C.B.S.E.), New Delhi.

   ii. Indian School Certificate Examination (12 Year course) of the Council for Indian School Certificate Examination, New Delhi.

   iii. B.Sc. (Gen.) Group „A" final Examination of the University of Delhi or equivalent examination.

   iv. B.Sc. (Hons.) Examination in Physics, chemistry and Mathematics of the University of Delhi with combination of Physics, Chemistry, Mathematics and equal weightage to the subsidiary subjects or equivalent examination.

   v. Any other examination recognized as equivalent to the Senior School Certificate Examination of the C.B.S.E by the University of Delhi.

   A candidate must additionally have passed English as a subject of study at the 12^{th} class level (core or elective)

NOTE: There shall be no direct admission to any level of the Courses above the Ist Semester.

3. Under each B.Tech. Degree course certain subjects are offered which can be classified as Theory/ Practical/ Drawing/ Design/ Project/ Practical Training. Further classification is based on the relationship of the subjects with the degree courses admitted to, namely Humanities and Social Science/ Basic Sciences/ Allied engineering, Departmental, core, etc.

   In addition to the above, a subject could be classified as a compulsory one or as one of the pre-requisite for another subject. The Committee of courses and Studies of the concerned Department shall do this classification.

4. A student who joins the first semester will be automatically deemed to have registered for the subjects which are listed under the first Semester of the SUGGESTED SCHEME OF LEARNING. Every student is required to register for the subjects to be taught in the second and subsequent semesters. This process of registration shall start just before the start of next semester. The student will also indicate during registration of subject/ subjects of earlier Semester(s) in which he/ she desire to appear, if otherwise eligible. Such a student will be allowed to appear in the End Semester Examination and his/ her marks of mid terms activities will remain unaltered since attendance is compulsory, a student will be permitted to register for course/ courses which he can attend. The number of theory subjects

permitted will not be more than six. The total duration of contact period should not ordinarily exceed thirty two hours per week.

5. B.Tech. Degree shall be awarded if a student has earned a minimum of 228 credits as specified in each degree program subject to break up and compulsory credit as mentioned there in. However, a student may register in subjects leading to a maximum of 240 credits in the entire course.

A student should keep a watch on his progress and register in those papers in which he must earn the credit to satisfy the above requirement of the particular degree.

If a student earns more than a specified minimum credit for degree the best marks in the minimum credits (satisfying the above conditions) will be considered for the purposes of classification of result.

6. Evaluation and Review

The committee of Courses & Studies in each Department shall specify the following for the degree course:-

(a) Suggested Scheme of Learning.

(b) Minimum credits needed for the degree course and break up in terms of classification of courses i.e.

a. Humanities and Social Sciences

b. Basic Sciences

c. Allied Engineering

d. Departmental Core

e. Practical Training

f. Unspecified/ Elective and

g. Project.

The committee of courses & Studies in each Department shall appoint one or more Evaluation-cum-Review Committees each dealing with group of subjects. This E.R.C consists of the teachers who are likely to teach subjects in the group.

The E.R.C. has the following functions:

i. To recommend appointment of paper setters/ examiners of various examinations at the start of each Semester.

ii. To get prepared quizzes, assignments, test papers etc. for the mid-term and the end semester examination and to get them evaluated. Normally each concerned teacher, who is also a member of E.R.C., will do this job for his class. However, in exceptional circumstances any part the work will be entrusted to some other member of E.R. C.

iii. The mode of evaluation of the mid-term activities whose weightage shall be 30% and the end of term examination whose weightages shall be 70% (The mid-term activities will be one mid term test or 20% weightage which will be supplemented by assignments, quizzes etc. for a theory course with weightage of 10%). For a practical course, 30% weightage be given for internal evaluation and 70% for End Semester Examination. At the end of the Semester, the E.R.C. Chairman will send to the University the consolidated marks for the mid-term activities and the End Semester in separate column for tabulation and for declaration of results.

iv. To consider the individual representation of students about evaluation and take the remedial action if needed. After scrutinizing the E.R.C may alter the marks awarded upward/ downward. The decision of the ERC shall be final. The candidate shall apply for the same on a prescribed performa along with the evaluation fee prescribed the University from time to time only for the end Semester Examination within seven days from the date of declaration of result.

v. To moderate the quiz/ assignment test papers given by each concerned teacher in class with a view to maintain uniformity of standards and course coverage amongst various classes and to attain stipulated level of learning.

vi. To review and moderate the mid term and end of term results of each class with a view to maintain uniformity of standards and course coverage amongst various classes and to attain stipulated level of learning.

vii. To lay guidelines for teaching a subject.

7. Classification of Result:

A student has to secure 40% or more marks in a subject evaluation to earn the credits assigned to the subject. A student after having secured the minimum credit as needed for the degree course will be eligible for the award of degree. The final result will be evaluated as below:

Each subject will carry 100 marks.

$$\text{average marks} = \frac{\sum(\text{Credits} \times \text{Marks Secured})}{(\sum \text{Credits})}$$

- (See clause 5 for best grades in the minimum credits)

The final result will be classified based on the average marks as follows.

First Class with Distinction 75% or more

First Class 60% or more but less than 75%

Second Class 50% or more but less than 60%

Pass Class 40% or more but less than 50%

8. A student has to put in a minimum of 75% attendance separately in each subject for which he has registered. A relaxation up to a maximum of 25% may be given on the production of satisfactory evidence that:

(a) The student was busy in authorized activities.

(b) The student was ill.

Note:- (i) A student should submit the evidence to the above fact within three working days of resuming the studies. Certificates submitted later will not be considered.

(ii) No relaxation in attendance beyond 25% is permitted in any case.

(iii) The registration of a student stands cancelled if his attendance requirements are not satisfied in the subject.

9. The duration of the course is not less than 8 Semesters and the span is not more than 14 semesters.

A student who earn 15 credits or less at the end of the first semester will receive a warning for his/her poor performance, if he fails to earn at least 25 credits at the end of the second semester, he has to leave the course and institution.

In case a student has not earned a minimum of 100 credits at the end of eight semester, his admission to the course and the institution stands cancelled. The admission stands cancelled at the end of 14 semester in any case.

10. The Institution /University may cancel the registration of all the subjects in a given semester if:

1. The student has not cleared the dues to the institution /hostel.
2. A punishment is awarded leading to the cancellation.

At discretion of the institution the result may be withheld even if the registration of the student stands.

11. There shall be a Central Advisory Committee consisting of the following:

(a) Dean, Faculty of Technology, (Chairman of the Committee)

(b) Heads, of the Institutions.

(c) Heads of the Departments in the Faculty of Technology.

This Committee shall have the following functions:

(i) lay guidelines for the process of registration.

(ii) give an interpretation of the rules in case of difference of opinion which shall be binding on all.

12. Under very exceptional conditions minor relaxations in rules may be allowed and implemented by the Central Advisory Committee. However, same relaxation in rules can not be granted in a subsequent semester. In case the conditions warrant such a relaxation again, the rules shall have to amended.

General Notes:

1. For all Theory Papers (Code:TH) there is one min-semester test of 30 marks (20+10 Assignments) and an end-semester exam. of 3 hours duration for 70 marks. The total marks for the Theory Papers is thus 100.

2. For all Practical Papers (Code: PR) there is semester assessment of 30 marks and an end semester exam of 3 hours or 4 hours duration for 70 marks. The total marks for the Practical paper is thus 100.

3. For all valuation of Sessional (Code ; VS) there is semester assessment of 100 marks. There is no end-semester exam for these courses. Credit of VS are not included in the total credits of semester. However, it is mandatory to pass the VS course.

4. At VII and VIII semester levels there is assessment of Practical Training Reports by a duly constituted Board. The report is to be submitted by summer /winter breaks. The total marks associated with each Practical Training Report is 100 marks of which 30 marks are awarded by the department on the basis of supervision of Industrial Training.

5. At VIII semester level there is assessment of Project Report by a duly constituted Board. The report is to be submitted by the student of the project work performed at the VII and VIII semester levels. The total marks associated with the project report is 100 marks of which 30 marks are awarded by the department on the basis of guidance of Project Work.

6. The total credits in all scheme of examination to B.E. Courses upto VIII semester will be 240 and the denominator for calculation of average marks for final result will be 228.

7. The project and the Practical Training after V & VI Semester are mandatory.

8. Candidates securing 236 to 240 credits are declared to have passed B.E. Final examination.

9. Candidates securing 229 to 235 credits are declared to have passed B.E. Final examination provided they skip/ fail in not more than 4 credits in CORE.

10. Candidates securing exactly 228 credits are declared to have passed B.E. Final examination, provided they skip/ fail in not more than 4 credits in core, not more than 4 credits in Applied Engineering, and not more than 4 credits in Applied Sciences & Humanities.

THIRD SEMESTER (CIVIL ENGINEERING)

S. No.	*Course No.*	*Subject*	*L-T-P*	*Evaluation*		*Total Marks*	*Credit Type*
				Sessional	End-Sem.		
TH1	CE 201	Strength of Materials	3-1-0	30	70	100	4C
TH2	MA 202	Mathematics & Numerical Methods	3-1-0	30	70	100	4H
TH3	EE 203	Elements of Electrical and Electronics Engineering	4-0-0	30	70	100	4A
TH4	CE 204	Surveying I	3-1-0	30	70	100	4C
TH5	HU205	Applied Economics & Management	3-1-0	30	70	100	4H
TH6	CE206	Building Materials & Construction	3-0-0	30	70	100	3C
PR1	CE 207	Strength of Materials Laboratory	0-0-2	30	70	100	2C
PR2	CE 208	Building Materials Lab	0-0-2	30	70	100	2C
PR3	CE 209	Surveying Laboratory	0-0-2	30	70	100	2C
VS 1	CE 210	Self Study Project - I	0-0-1	30	70	100	1C
	TOTAL		**30 hrs**			**1000**	**30**

FOURTH SEMESTER (CIVIL ENGINEERING)

S. No.	*Course No.*	*Subject*	*L-T-P*	*Evaluation*		*Total Marks*	*Credit Type*
				Sessional	End-Sem.		
TH1	CE 211	Fluid Mechanics	3-1-0	30	70	100	4C
TH2	CE 212	Engineering Geology	4-0-0	30	70	100	4C
TH3	CE 213	Design of Structural Elements	3-1-0	30	70	100	4C
TH4	CE 214	Surveying II	3-1-0	30	70	100	4C
TH5	CE215	Structural Analysis I	3-1-0	30	70	100	4C
TH6	ME216	Fundamentals of Mechanical Engineering	3-0-0	30	70	100	3A
PR1	CE 217	Fluid Mechanics Laboratory	0-0-2	30	70	100	2C
PR2	CE 218	Engineering Geology Laboratory	0-0-2	30	70	100	2C
PR3	CE 219	Structures Laboratory	0-0-2	30	70	100	2C
VS 2	CE 220	Self Study Project – II	0-0-1	30	70	100	1C
	TOTAL		**30 hrs**			**1000**	**30**

NOTE: Students will undertake Three weeks of Survey Camp during summer break after fourth semester.

FIFTH SEMESTER (CIVIL ENGINEERING)

S. No.	*Course No.*	*Subject*	*L-T-P*	*Evaluation*		*Total Marks*	*Credit Type*
				Sessional	End-Sem.		
TH1	CE 301	Geotechnical Engineering I	3-1-0	30	70	100	4C
TH2	CE 302	Hydraulics & Hydraulic Machines	3-1-0	30	70	100	4C
TH3	CE 303	Environmental Engineering I	3-1-0	30	70	100	4C
TH4	CE 304	Structural Analysis II	3-1-0	30	70	100	4C
TH5	CE305	Water Resources Engineering	3-1-0	30	70	100	4C
PR1	CE 306	Geotechnical Engineering I Laboratory	0-0-2	30	70	100	2C
PR2	CE 307	Hydraulics & Hydraulic Machines Laboratory	0-0-2	30	70	100	2C
PR3	CE 308	Environmental Engineering Laboratory	0-0-2	30	70	100	2C
PR4	CE 309	Minor Project – I	0-0-2	30	70	100	2C
PR5	CE 310	Survey Camp Evaluation	0-0-2	30	70	100	2M
	TOTAL		**30 hrs**			**1000**	**30**

NOTE: Students will undertake Four weeks of Industrial Training during winter break after fifth semester.

SIXTH SEMESTER (CIVIL ENGINEERING)

S. No.	*Course No.*	*Subject*	*L-T-P*	*Evaluation*		*Total Marks*	*Credit Type*
				Sessional	End-Sem.		
TH1	CE 311	Design of Steel Structures	3-1-0	30	70	100	4C
TH2	CE 312	Environmental Engineering II	3-1-0	30	70	100	4C
TH3	CE 313	Geotechnical Engineering II	3-1-0	30	70	100	4C
TH4	CE 314	Transportation Engineering I	3-1-0	30	70	100	4C
TH5	CE315	Estimation, Costing and Work Procedures	3-1-0	30	70	100	4C
PR1	CE 316	Geotechnical Engineering II Laboratory	0-0-2	30	70	100	2C
PR2	CE 317	Transportation Engineering Laboratory	0-0-2	30	70	100	2C
PR3	CE 318	Minor Project – II	0-0-4	50	150	200	4C
PR4	CE 319	Industrial Training – I (Examination)	0-0-2			100	2C
	TOTAL		**30 hrs**			**1000**	**30**

NOTE: Students will undertake Six weeks of Industrial Training during summer break after sixth semester.

SEVENTH SEMESTER (CIVIL ENGINEERING)

S. No.	*Course No.*	*Subject*	*L-T-P*	*Evaluation*		*Total Marks*	*Credit Type*
				Sessional	End-Sem.		
TH1	CE 401	Design of Concrete Structures	3-1-0	30	70	100	4C
TH2	CE 402	Transportation Engineering II	3-1-0	30	70	100	4C
TH3	CE 403	Construction Technology and Management	3-1-0	30	70	100	4C
TH4	CE	Elective I	3-1-0	30	70	100	4C
PR1	CE 404	Planning & Management Lab	0-0-3	30	70	100	3C
PR2	CE 405	Design & Drawing Lab	0-0-3	30	70	100	3C
PR3	CE 406	Industrial Training – II	0-0-4	50	150	200	4M
PR4	CE 407	Major Project (Part I)	0-0-4	50	150	200	4M
	TOTAL		**30 hrs**			**1000**	**30**

EIGHTH SEMESTER (CIVIL ENGINEERING)

S. No.	*Course No.*	*Subject*	*L-T-P*	*Evaluation*		*Total Marks*	*Credit Type*
				Sessional	End-Sem.		
TH1	CE 411	Prestressed Concrete	4-0-0	30	70	100	4C
TH2	CE	Elective – II	4-0-0	30	70	100	4C
TH3		Elective – III (Open)	4-0-0	30	70	100	4A/H
PR1	CE	Elective – II - Laboratory	0-0-3	30	70	100	3C
PR2		Elective – III - Laboratory	0-0-3	30	70	100	3A/H
PR3	CE 412	Project Part II	0-0-10	100	300	400	10M
PR4	CE 413	Seminar	0-0-2	100	--	100	2M
	TOTAL		**30 hrs**			**1000**	**30**

LIST OF ELECTIVES

Elective – I

CE 4101	Advanced Theory of Structures
CE 4102	Seismic Design of Structures
CE 4103	Soil Structure Interaction
CE 4104	Rock Mechanics
CE 4105	Structural Dynamics
CE 4106	Design of Hydraulic Structures
CE 4107	Geotechnical Earthquake Engineering
CE 4108	Earth and Earth Retaining Structures
CE 4109	Environmental Impact Assessment and Audit
CE 4110	Solid Waste Management

Elective – II

CE 4201	Design of Tall Buildings
CE 4202	Groundwater and Seepage
CE 4203	Foundation Engineering
CE 4204	Environmental Geotechnology
CE 4205	Ground Improvement Technology
CE 4206	Soil Dynamics and Machine Foundations
CE 4207	Material Science & Technology
CE 4208	Environmental Planning and Management
CE 4209	Disaster Management
CE 4210	Town Planning and Architecture

Elective – III : Open Electives

The students can choose any elective offered by other departments.

THIRD SEMESTER

B. Tech., III Semester Examination
CE-201 Strength of Materials

L	T	P	Credits
3	1	0	4C

UNIT 1 Analysis of Stresses: Stress tensor, Principal stresses, Transformation equations, Stress invariants, Plane stress, Mohr's circle for plane stress, Octahedral stresses, Differential equations of equilibrium, Components of stresses in cylindrical polar coordinates. Material properties.

UNIT 2 Analysis of Strain: Deformable bodies, Concepts of normal strain and shear strain, Strain components at a point, Transformation equations, Principal strains, Mohr"s circle for strains, Compatibility conditions, Displacement equation of equilibrium, Plane strain.

UNIT 3 Stress-Strain relations: Uniaxial tensile test, Elasticity, Anelasiticity, Work-hardening, anisotrophy, homogeneity and continuity, Generalized Hooke's law, Lame's constants, Modules of rigidity, Bulk modules, Relation between the elastic constants, Principle of superposition, Uniqueness theorem, Thermal effects.

UNIT 4 Uniaxial Loading: Bars of variable cross-section, Statically indetermine problems in tension and compression, Thin cylindrical and spherical vessels.

UNIT 5 Deflections due to bending: The moment curvature relation, Macaulay's and moment-area method, Castigliano's theorem. **Stability of Columns:** Stable and unstable equilibrium, Euler's

formula for long columns, Rankine's formula. **Springs:** Types of springs, Close coiled and open coiled springs, Torsion and shear centre..

References

1. Feodosyev, V., "Strength of Materials", Mir Publishers, Moscow.
2. Benham, P.P., & Warnock, F.V., "Mechanics & Solids & Structures", Pitman Publishing, London.
3. Seely, F. B. & Smith, J. O., "Advanced Mechanics of Materials", Tokyo, Toppan.
4. Shaneloy, F.R., "Strength of Materials", McGraw Hill Book Company.
5. Timoshenko, S., "Strength of Materials", Vol. I, McGraw Hill Book company.
6. S. H. Crandall, N.C. Dahal & T. J. Lardener, "An introduction to the mechanics of Solids", McGraw Hill Books Co.
7. I. H. Shames, "Introduction to solid mechnics", Prentice Hall of India Ltd.

B.Tech. IIIrd Semester Examination
MA 202 Mathematics and Numerical Methods

L	T	P	Credit
3	1	0	4H

Differential Equations: Bessel"s equation, Bessel functions of first kind, recurrence relations; Legendre"s equation, Legendre"s polynomials, Rodrigue"s formula.

Fourier Series: Fourier series, Euler"s formulae, even and odd functions; Functions having arbitrary period; Half range expansions; Harmonic analysis.

Vector Analysis : Review of vector algebra; Triple product; differentiation of vectors; Operators grad; div and curl, their geometrical and physical significance; Integration of vectors, work dome in vector fields, green"s, stock"s and Gause divergence theorem.

Functions of Complex Variables: Analytic functions, Harmonic conjugate, conformal transformation of functions (simple problems), Cauchy"s integral theorem, Cauchy"s integral formula, residues, residue theorem.

Numerical Analysis: .Approximations and round off errors, Truncation errors and Taylor Series. Determination of roots of polynomials and transcendental equations by Newton-Raphson, Secant and Bairstow"s method. Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss-Siedel iteration methods. Curve fitting-linear and nonlinear regression analysis. Backward, Forward and Central difference relations and their uses in Numerical differentiation and integration, Application of difference relations in the solution of partial differential equations. Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.

B.Tech III Semester Examination
EE 203 Elements of Electrical and Electronics Engineering

L	T	P	Credits
3	1	0	4H

UNIT 1 Electric Current & Ohms law: Resistance, Effect of temperature on resistance – series & Parallel circuits. Electric Circuits & Network Theorems: Kirchoff"s laws, Maxwell"s loop current method – Superposition theorem, thevenin"s theorem, Star – Delta Transformations, Maximum power trnansfer theorem. Capacitor : Capacitance – Units, Capacitor in series & parallel, insulation resistance of a cable, current and voltage relationship in a capacitor.

UNIT 2 Magnetism & Electro Magnetism : Magnetic flux, flux density and magnetism field intensity, Magnetic field due to a current carrying conductor, concept of permeability. Magnetic Circuit : mmf Reluctance , Magnetic Hysterisis. Electro Magnetic Induction : Faraday"s laws of electromagnetic induction, Growth & decay of current in inductive circuits, energy stored in magnetic field. Fundamental of Alternating Current : Production of a.c. voltage, Phase & phase difference, phasor representation of an alternating quantity, a.c. circuits – series and parallel.

UNIT 3 Three phase as system and transformer : Line & phase quantities for star and delta connected circuits. Power in thjree phase system with balanced load – Introduction to transformer operating principles, emf equations, transformation ratios, transformer on no-load & on load. Equivalent circuit, regulation efficiency. Three phase transformers & auto transformer.

UNIT 4 Semi-conductors, current carriers in semi conductors, p-n junction diode, transistor, zener diode & thyristor their operation & characterstic, Amplifier circuits – frequency response hybrid parameters, equivalent circuit for common emitter configuration , current and voltage gain, input and output impedance.

UNIT 5 Field effect transistors: Characterstic and application in typical amplifier circuits. CMOS – characterstic & application. Thyristors characterstics and applications. Integrated circuits : OPAMP & timer with typical applications . introduction to logic circuits , digital ICs & their applications. Oscillators and RF signal generators.

B. Tech. III Semester Examination
CE-204 Surveying I

L	T	P	Credits
3	0	0	3C

UNIT 1 **Introduction:** Importance of Surveying to Engineers-Example from different branches; Plane and Geodetic surveying, Control points, Classification of surveys, Methods of location a point, Sources and Types, Principle of working from whole to part, Organization of field and office work, conventional signs, Surveying instruments, their care and adjustment, Principle of reversal. **Measurement of Distances:** Principles of different methods and their accuracies, Measurement by chain and tape. Source of errors and precautions, Corrections to tape measurements, Field problems, Use and adjustment of auxiliary instruments, Modern trends EDM and Total Station.

UNIT 2 **Measurement of Angles and Directions:** Reference meridians, Bearing and azimuths, Magnetic declination and its variations. Use and adjustment of compass, Vernier and microptic theodolites, Temporary and permanent adjustments, Requirements of non-adjustable parts, Measurement of horizontal and vertical angles by different methods. **Traversing:** Principles of traversing by compass and theodolite, Field work and checks, Computation of coordinates, Sources of errors, Precision of traversing, Checking and adjusting of traverses, Omitted measurements.

UNIT 3 **Measurement of Elevations:** Different methods of determining elevations: spirit, Trigonometric, Barometric and Photogrammetric methods, Spirit leveling-Definitions of terms, Principle, Construction, Temporary and permanent adjustment of levels. Sensitivity of bubble tube, Automatic levels, Levelling staves, Methods of spirit leveling Booking and reduction of fields notes, Curvature and refraction, Reciprocal levelling, Plotting of profiles, Barometric leveling, Construction and field use of altimeter, Trigonometric leveling-simple and reciprocal observations, Sources of errors and precision of leveling procedures.

UNIT 4 **Tacheometry:** Definitions, Principles of stadia systems, Instrument constants, Substance and Tangential Systems, Construction and use if Reduction Tacheometers, Range Finders, Errors and Precision.

UNIT 5 **Contouring:** Methods of relief representations, Definitions and characteristics of contours. Use of contour maps, Direct and Indirect methods of contouring. **Sheet Numbering Systems:** CIM and I. and A. C. series, Scales and Numbering of Indian Topographic maps.

References

1. Agor, R, "Surveying", Vol. I & II, Khanna Publications, Delhi.
2. Arora, K.R., "Surveying", Vol. I & II, Standard Book House, Delhi.
3. Bannister, A. and Baker, R., "Solving Problems in Surveying", Longman Scientific Technical, U.K..

4. Kennie, T.J.M. and Petrie, G., "Engineering Surveying Technology", Blackie & Sons Ltd, London.
5. Punmia, B.C., "Surveying", Vol. I & II, Laxmi Publications, New Delhi.

B. Tech. III Semester Examination
HU 205 Applied Economics & management

L	T	P	Credits
3	1	0	4H

B. Tech. III Semester Examination
CE-206 Building Materials and Construction

L	T	P	Credits
3	0	0	3C

UNIT 1 **Building Materials:** Bricks, Stone, Lime, Timber, plywood, glass, plastics, steel, aluminum: classification, properties and selection criteria. Cement, aggregate, admixtures: types, properties, selection criteria and tests. Preparation and properties of concrete, concrete mix design. Introduction to destructive and non-destructive tests. Mortar: Types, classification and strength, I.S. specifications.

UNIT 2 **Cement:** Types, Composition, Properties, Uses and specifications. Tests on cement-normal consistency, initial setting, final setting, tensile and compressive strengths, unsoundness, fineness, heart of hydration. **Aggregates:** Classification, properties, porosity and absorption, bulking of sand, sieve analysis; grading curves, fineness modulus, impurities and tests on aggregates. **Lime and Cement Mortars:** Concrete: Properties, workability-Slump Test, Compaction-factor test and Vee-Bee consistometer test; bleeding, shrinkage and creep, mixing and placing of concrete, compressive and tensile strengths, effects of water-cement ratio, compaction, age, curing temperature on strength of concrete, Modules of elasticity. Poisson"s ratio.

UNIT 3 **Design of concrete mixes:** Proportioning of aggregates, ACI and other methods of mix design.

UNIT 4 **Building Construction:** Building byelaws, modular co-ordination. Loads on buildings. Types of foundations and selection criteria. Brick masonry, stone masonry, bonds. Types of walls, partition and cavity walls, design criteria. Prefabricated construction. Plastering and pointing. Dampness in buildings, its causes and effects. Damp proofing materials and techniques.

UNIT 5 **Building Construction:** Types of floors, construction details and selection criteria. Types of roofs and roof covering, treatment for water proofing. Doors and windows: sizes and locations, materials. Stair and staircases: types, materials, and proportions. Lifts and escalators. White washing, colour washing, painting, distempering. Shuttering, scaffolding and centering. Expansion and construction joints. Acoustics & sound and fire proof construction, I.S. specifications.

References

1. Arora, S. P. & Bindra, S. P., "A text book of Building Construction", Dhanpat Rai & Sons, Delhi.
2. Jha, J. & Sinha, S. K., "Building Construction", Khanna Publishers, Delhi.
3. Kulkarni, C.J., "A text book of Engineering Materials", Ahmedabad Book Depot, Ahmedabad.
4. Kulkarni, C. J., "A text book of Engineering Construction", Ahmedabad Book Depot, Ahmedabad.
5. Kumar Suhil, "Engineering Materials", Standard Publishers Distributors, Delhi.
6. Kumar Sushil, "Building Construction", Standard Publishers Distributors, Delhi.
7. McKay W.B., "Building Construction, "Vol.1 to 4, Orient Longman Ltd., Hyderabad, Bombay, Madras, Delhi, Vol. 1& 2-1995, Vol.3-1996, Vol.4-1998.
8. Punmia, B. C., "A text book of Building Construction", Laxmi Publications, Delhi, Madras.
9. Singh Surendra, "Engineering Materials", Konark Publishers Pvt. Ltd.

B.TECH. III Semester Examination
CE-207 Strength of Material Laboratory

L	T	P	Credits
0	0	2	2C

List of Experiments (new experiments may also be designed)

1. Introduction to testing equipments.
2. Uniaxial tension test (Mild steel, Timber)
3. Uniaxial compression test (Timber-along and across, concrete, bricks, etc.)
4. Torsion test (Mild Steel/Aluminum)
5. Bending stress distribution in beams using demec gauges and extensometer.
6. Analysis of truss model with spring members.
7. Compression test on brick masonry specimen.
8. Hardness Test
9. Creep Test
10. Impact Test
11. Strength of Etched and Un-etched glass.
12. Spring Test
13. To study the microstructure of various metals.

B.TECH. III Semester Examination
CE-208 Building materials Lab

L	T	P	Credits
0	0	2	2C

List of Experiments (new experiments may also be designed)

1. Initial drying shrinkage, moisture movement and coefficient of expansion of concrete.
2. Stress strain curve for concrete
3. Behaviour of under reinforced and over reinforced RC beam in flexure.
4. Behaviour of RC beams, with or without shear reinforcement in shear.
5. Bond strength between steel bar and concrete (a) in a beam specimen and (b) by pull out test.
6. (a) Fineness of cement by air permeability method.
   (b) Soundness of cement by Le Chatelier"s Apparatus.
   (c) Compressive strength of cement.
7. (a) Water content for standard consistency of cement
   (b) Initial and final setting times of cement
8. Moisture content and bulking of fine aggregates
9. Fineness modulus of coarse and fine aggregates
10. Workability of cement concrete by (a) Slump test and (b) Compaction factor test.
11. Concrete mix design for a given concrete strength and slump by IS code method.

B.TECH. III Semester Examination
CE-209 Surveying Laboratory

L	T	P	Credits
0	0	2	2C

List of Experiments (new experiments may also be designed)

1. Study of different Levels and Levelling staff. Practice for temporary adjustment. To find out the reduced levels of given points using Dumpy level. (Reduction by Height of Collimation method).
2. Study of a Tilting (I.O.P) Level and to find out the reduced levels of given points (Reduction of data by Rise and Fall method).
3. Visit to Lab for the study of :
   (a) Map in the making-survey of India publication
   (b) Conventional Symbol charts and Different types of maps.
4. To establish a Bench Mark by check Levelling with I.O.P. level and closing the work at the starting Bench Mark.
5. To perform Fly Levelling with a I.O.P. level.
6. To draw the longitudinal and cross-sections profiles along a given route.

7. Practice for Temporary adjustments of a Vernier Theodolite and taking Horizontal and Vertical angular measurements, by Reiteration method.
8. (i) Measurement of a horizontal angles by Repetition method at three zeros and four repetitions.
(ii) Determination of elevation and horizontal distance of a given point using Substance Bar and a Vernier Theodolite.
9. (i) Determination of the Tachemetric constants of a given Theodolite.
(ii) To determine the gradient between two given points using Tacheometric method.
10. To determine the bearing of a given traverse using Prismatic Compass, and plotting of the traverse.
11. Establishment of a given traverse using Tacheometric method.
12. Determination of elevations of a given point by Trigometrical Levelling.
13. Study and use of different types of Micro-optics Theodolites and Total Station.

B.TECH. III Semester Examination
CE-210 Self Study - I

L	T	P	Credits
0	0	1	1A

FOURTH SEMESTER

B.TECH. IV Semester Examination
CE-211 Fluid Mechanics

L	T	P	Credits
3	1	0	4C

UNIT 1 **Introduction:** Fluids and continuum, Physical properties of fluids, ideal and real fluids, Newtonian and non-Newtonian fluids, measurement of surface tension. **Fluid Statics:** Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, center of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations, measurement of pressure.

UNIT 2 **Kinematics of Fluid Flow:** Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, one, two, and three dimensional flows, streamlines, streak lines an path lines, continuity equation, rotation and circulation, elementary explanation of stream function and velocity potential, graphical and experimental methods of drawing flow nets.

UNIT 3 **Dynamics of Fluid Flow:** Euler‟s equation of motion along a streamliner and its integration, Bernoulli‟s equation and its applications-Pitot tube, flow through orifices, mouthpieces, nozzles, weirs, sluice gates under free and submerged flow conditions, Aeration of nappe, cavitation, free and forced vortex, momentum equation and its application to stationary and moving vanes, pipe bends, Problems related to combined application of energy and momentum equations. **Dimensional Analysis and Hydraulic Similitude:** Dimensional analysis, Buckingham‟s theorem, important dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies.

UNIT 4 **Laminar and Turbulent Flow:** Equation of motion for laminar flow through pipes, Stoke‟s law, flow between parallel plates, flow through porous media, fluidization, measurement of viscosity, transition from laminar to turbulents flow, turbulent flow, equation for turbulent flow, eddy viscosity, mixing length concept and velocity distribution in turbulent flow, Hot-wire anemometer and LDA.

UNIT 5 **Pipe Flow:** Nature of turbulent flow in pipes, equation for velocity distribution over smooth and rough surface resistance coefficient and its variation, flow in sudden expansion, contraction, diffusers, bend valves and siphons, concept of equivalent length, branched pipes, pipes in series and parallel simple networks, pumps and turbines, transmission of power.

References

1. Garde, R. J. and A. G. Mirajgaoker, "Engineering Fluid Mechnics (including Hydraulic Machines)", Second Ed., Nem Chand & Bros, Roorkee, 1983.
2. Garde, R. J., "Fluid Mechnics through Problems", Wiley Eastern Limited, New Delhi, 1989.
3. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons, Inc., 1946.
4. L. H. Shames, "Mechanics of Fluids", McGraw Hill, Int. Student, Education.
5. Vijay Gupta and S. K. Gupta, "fluid Mechanics and its Applications", Wiley Eastern Ltd.

B.TECH. IV Semester Examination
CE-212 Engineering Geology

L	T	P	Credits
3	0	0	3C

UNIT 1 **Introduction:** Definition & Scope of geology, branches of geology, importance of geology in engineering, origin of earth, age of earth, interior of earth, earth movement.
Materials of Crust:
Crystals: Definition, terminology, crystallographic axes, study of various systems.
Minerals: Physical properties, optical properties, rock and ore forming minerals, important mineral families.
Rocks: Rock cycle, physical properties and petrological characters of igneous, metamorphic and sedimentary rocks, their texture, mode of occurance and classification.

UNIT 2: **Weathering:** Types of weathering and factors which influence weathering, resulting features and importance in engineering. **Erosion:** By running water, by glaciers, by lakes and their engineering importance. Physiographic features of India.

UNIT 3: **Structural Geology:** Attitude of bed; dip, strike true and apparent dip. **Faults:** Definitions classifications, recognition in field and causes, fault in relation to engineering operations. **Folds:** Definitions, classification, causes, fault in relation to engineering operation. **Joints:**Definition and classification, engineering importance.

UNIT 4 **Stratigraphy:** Definition, principle of correlation, fossils, geological time scale, important systems of Indian stratigraphy. Geomicrobiology.

UNIT 5; **Applied Geology:** Recks as engineering material, building stones, ground water, earth-quakes, land slides-causes and their prevention, land subsidence-causes and prevention; geological investigation for dam and reservoir, bridges, highways and buildings, site selection and criteria for tunnels, formation and genetic classification of soils, soil erosion, prevention measures, soil groups of India.

B.TECH. IV Semester Examination
CE-213 Design of Structural Elements

L	T	P	Credits
3	1	0	4C

UNIT 1 Material Properties: Properties of concrete and reinforced steel, characteristic strength, stress strain curve, IS specifications. Design Philosophies: Working stress, ultimate strength and limit state of design.

UNIT 2 Analysis and design of section in bending: Flexure of beams by working stress and limit state method, singly and doubly reinforced section, T and L section, Shear and Bond: Behaviour of beam in shear and bond, design for shear , anchorage and splicing of reinforcement, detailing of reinforcement

UNIT 3 Serviceability Condition: Limit state of deflection and cracking, calculation of deflection. Design of Column: Short and long column, eccentrically loaded column

UNIT 4 Structural Steels, design philosophies, loads and their combinations, methods of analysis, Partial safety factors for loads and materials, connections. Design of tension members, various sections, lug angles, splices and gussets.

UNIT 5 Design of compression members, built up members, lacing & batten plates and column bases. Design of beams, section classifications, lateral supported and unsupported, web crippling & buckling, unsymmetrical bending and design.

References

1. Krishna, J. and Jain, O.P., " Plain and reinforced concrete", Vol-II Nem Chand and Bros., Roorkee.
2. Chandra Ram "design of concrete structures" Vol-II Standard Book House, New Delhi.

B.TECH. IV Semester Examination
CE-214 Surveying II

L	T	P	Credits
3	1	0	4C

UNIT 1 **Plane Table Surveys:** Principles, Advantages and disadvantages, Plane Table Equipment, Use of Telescopic Alidae Indian Pattern Tangent Clinometer, Different methods of Plane Table Surveying, Resection-I and three point problems, Fields work in Plane Table Surveying and controlling.

UNIT 2 **Trilateration and Triangulation:** Principle of Trilateration, EDM instrument and their uses, Reduction of observation, Principle classification of Triangulation System, Triangulation chains, Strength of Figures. Station Marks signals, Satellite station, Intersected and Resected points, fields work-Reconnaissance, Intervisible of station, Angular Measurement, Base Line Measurement and it extension, Adjustment of observation and Computation of co-ordiantes.

UNIT 3 **Adjustment Computations:** Weighting of observations, Treatment of random errors, probability equation, Normal law of error Most Probable Value & measures of precision, Propagation of errors and variances, Most Probably value Principle of Least Square, Observations and correlative Normal Equations, Adjustment triangulation figures and level nets.

UNIT 4 **Curves:** Classification of curves; Elements of Circular, Transition and Vertical curves, Theory and methods of setting out simple, Transition and Vertical curves, special field problems.

UNIT 5 **Project Surveys:** General requirement and specifications for Engineering project surveys, Reconnaissance, Preliminary and Locations surveys for highways, railways and canals. Correlation of surface and undergroven surveys in case of Culverts, Bridges and Tunnels; Principles and practice of hydrographic survey Layout of culverts, canals, bridges and buildings.

References

1. Agor, R, "Surveying", Vol. II & III, Khanna Publications, Delhi.
2. Arora, K. R., "Surveying", Vol. II & III, Standard Book House, Delhi.
3. Bannister, A. and Baker, R., "Solving Problems in Surveying", Longman Scientific Technical, U. K.
4. Kennie, T. J.M. and Petrie, G., "Engineering Surveying Technology", Blackie & Sons Ltd, London.
5. Punmia, B. C., "Surveying", Vol. II & III, Laxmi Publications, New Delhi.

B.TECH. IV Semester Examination
CE-215 Structural Analysis I

L	T	P	Credits
3	1	0	4C

UNIT 1 Classification of Structures, stress resultants, degrees of freedom per node, static and kinematic Indeterminacy.

UNIT 2 Classification of Pin jointed determinate trusses, Analysis of determinate plane and space trusses (compound and complex). Method of Substitution and Method of tension coefficient.

UNIT 3 Analysis of determine beams & plane frames, bending moment, shear force diagrams and axial thrust diagrams, Elastic curve (sketch). Rolling loads influence lines for beams and trusses, Absolute maximum bending moment.

UNIT 4 Analysis of Arches, Linear arch, Eddy"s theorem, three hinged parabolic arch, spandral braced arch, moving load & influence lines. Strain Energy of deformable systems, Maxwell"s reciprocal & Betti"s theorem, Castigliano"s first theorem, unit load & influence lines.

UNIT 5 Unsymmetrical bending, location of neutral axis, computation of stresses and deflection, Shear center- its location for common structural section. Bending of curved bars in plane of bending, stresses in bars of small & large initial curvatures.

References

1. Wilbur and Norris, "Elementary Structural Analysis", Tata McGraw Hill.
2. Reddy, C. S., "Basic Structural Analysis", Tata McGraw Hill.
3. Jain, O. P. and Jain, B. K., "Theory & Analysis of Structures", Vol. I & II, Nem Chand.
4. Coates, R. C., coutie, M. G. & Kong, F. K., "structural Analysis", English Language Book Society & Nelson.
5. Ghali, A. & Neville, M., "Structural Analysis", Chapman & Hall Publications.
6. B.TECH. (Civil Engg.) II Year IV Semester Examination Practical (Sessional Work)
7. Paper I-CE 220 L-Workshop Training) held after Third Semester.

B.TECH. IV Semester Examination
ME-216 Fundamentals of Mechanical Engineering

L	T	P	Credits
3	0	0	3 A

UNIT 1 **Thermodynamics:** Basic Concepts – systems, properties, equilibrium, Zeroth Law, heat and work, point and path functions. First law of thermodynamics, basic thermodynamic processes for ideal gases, non flow and steady flow energy equations;

UNIT 2 Second law of thermodynamics, reversibility, Carnot cycle, entropy, various processes on T-s and H-s planes; saturated and superheated steam, steam tables and Moller diagram.

UNIT 3 **I.C. Engines:** Ideal heat engine cycle – S.I. engine cycles : Two and Four stroke operation engines, value timing diagram, detonation, preignition and knocking, carburetion and fuel injection, engine performance testing.

UNIT 4 **Air compressors:** Reciprocating air compressors, single and multi stage compression, clearance and volumetric efficiency. Rotary compressors.

UNIT 5 **Heat Transfer:** Basic modes of heat transfer- conduction, convection and radiation; thermal resistance and potential, overall heat transfer coefficient; elementary treatment of one dimensional heat transfer calculations.

B.TECH. IV Semester Examination
CE-217 Fluid Mechanics Laboratory

L	T	P	Credits
0	0	2	2 C

List of Experiments (new experiments may also be designed)

1. To determine experimentally the metacentric height of a ship model.
2. To verify the momentum equation experimentally.
3. To determine the coefficient of discharge of an orifice (or a mouth piece) of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice (or the mouth piece).
4. To plot the flow net for a given model using the concept of electrical analogy.
5. To measure surface tension of a liquid.
6. To obtain the surface profile and the total head distribution of a forced vortex.

7. To caliber an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.
8. To verify Darcy‟s law and to find out the coefficient of permeability of the given medium.
9. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
10. To study the velocity distribution in a pipe and also to compute the discharge by integrating velocity profile.
11. To study the variation of friction factor, „f‟ for turbulent flow in smooth and rough commerce pipes.
12. To determine the loss coefficient for the pipe fittings.
13. To study the flow behaviour in a pipe bend and to calibrate the pipe bend for discharge measurement.
14. To measure the pressure distribution around a cylinder placed in a wind stress and to calculate the coefficient of drag.
15. To caliber a venturi-meter and to study the variation of coefficient of discharge with the Reynolds number.

References

1. Garde, R. J., and A. G. Mirajgaoker, "Engineering Fluid Mechanics (including Hydraulic Mechanics)", 2nd Ed., Nem chand & Bros., Roorkee, 1983.
2. Garde, R. J., "Fluid Mechanics through Problems", Wiley Eastern Limited, New Delhi, 1989.
3. Streeter, V. L. and Wylie, E. B., "Fluid Mechanics", McGraw Hill, New York, 8th Ed., 1985.
4. Asawa, G. L., "Experimental Fluid Mechanics", Vol. 1, Nem Chand and Bros., Roorkee, 1992.

B.TECH. IV Semester Examination
CE-218 Engineering Geology Lab

L	T	P	Credits
0	0	2	2C

Experiments on

1. Study of rock forming and Economic minerals, study of different rocks.
2. Methods of completing the outrop of rocks on a map.
3. Drawing the geological sections of geological maps.
4. Inter-relation of geological maps and sections with respect to subsurface structure.
5. Problems of locating sites of projects like Dams, Tunnels, Highways etc. In the geological sections.

References

1. Prabin Singh. "Engineering and General Geology", Katson Publishing House.
2. Leggot, R. F., "Geology and Engineering", McGraw Hill, New York.
3. Blyth, F. G. M., "A Geology for Engineers", Arnold, London.
4. P. K. Mukherjee, "A Text Book of Geology", Calcutta, World Publisher.

B.TECH. IV Semester Examination
CE-219 Structures Laboratory

L	T	P	Credits
0	0	2	2C

List of experiments: **(new experiments may also be designed)**

1. Clark Maxwells Reciprocal theorem using a beam.
2. Analysis of a redundant joint
3. (a) Deflections of a truss (b) Maxwells Reciprocal theorem
4. Elastic Displacements of curved members
5. Elastic properties of beams
6. 3-hinged arch
7. 2-hinged arch
8. Behaviour of struts

9. Experimental and analytical study of three bar pin-jointed truss
10. Experimental and analytical study of deformations in bar beam combination

B.TECH. IV Semester Examination
CE-220 Self Study II

L	T	P	Credits
0	0	1	1A/C

FIFTH SEMESTER

B.TECH. V Semester Examination
CE301-Geotechnical Engineering – I

L	T	P	Credits
3	1	0	4C

UNIT 1 Introduction: Introduction to soil mechanics and geotechnical engineering, importance in civil engineering, nature of soil, soil formation and soil type. **Simple Soil Properties:** Basic definitions, phase relations, index properties, basic concepts of clay minerals and soil structure.

UNIT 2 Soil Classification and Identification: Field identification, Textural Classification, Unified Soil Classification Syatem, Indian Standard Soil Classification syatem, Group Index. **Hydraulic Conductivity:** hydraulic conductivity or permeability, Darcy˝s law, Discharge and Seepage velocities, Laboratoty methods of determination, Factors affecting hydraulic conductivity, Hydraulic conductivity of layered soils, Field determination of hydraulic conductivity, Neutral and effective stresses, Critical hydraulic gradient, Capillary water in soils.

UNIT 3 Seepage: Laplace˝s equation for simple flow problems, Flow nets, Seepage calculation from flow nets, Flow nets in anisotropic soil, Seepage pressure, Uplift pressure, Seepage through earth dams, Exit gradient, Piping, Criterfia for design of filters. **Compaction:** General principals, Laboratory determination, Factors affecting compaction, Field compaction, Compaction of cohesionless and cohesive soils, Field control of compaction.

UNIT 4: Stress Distribution: Elastic constants of soils and their determination, Boussinesq equation for vertical stress, The Westergaard equation, Stress distribution under loaded areas, Concept of pressure bulb; Newmark˝s influence chart, contact pressure. **Shear Strength:** Introduction, Mohr˝s circle of stress, Mohr-Coulomb failure theory, Shear strength parameters, Various Laboratory tests for measurement of shear strength, UU, CU and CD tests and their relevance to field problems, Plotting of test data, Shear strength characteristics of Normally consolidated and over consolidated clays, shear strength characteristics of sands.

UNIT 5 Compressibility and Consolidation: Importance of compressibility, Effect of soil type, stress history and effective stress on compressibility, Factors affecting consolidation and compressibility, Normally consolidated and over consolidated soils, Void ratio-pressure relationship, Coefficient of compressibility and Volume change, Mechanism of consolidation, Terzaghi˝s theory of consolidation, Laboratory consolidation tests and analysis of data, Determination of Cofficient of Consolidation.

Books/References

1. Gopalranjan and Rao, ASR " basic and applied soil mechanics" (revised edition), New Age International, New Delhi.
2. Holtz R and Kovacs, WD " Introduction to geotechnical engineering" John Wiley New York.
3. Lambe, TW and Whitman RV " Soil mechanics in engineering practice" John Wiley, New York.
4. Lambe, TW " Soil testing for engineers" John Wiley, New York.
5. Soil Mechanics and Foundation engineering by VNS Murthy, Sai Kripa.\
6. Soil Mechanics and foundation by BC Punmia, Laxmi Publication.

B.TECH. V Semester Examination
CE 302- Hydraulics and Hydraulic Machines

L	T	P	Credits
3	1	0	4C

UNIT 1: Introduction: Types of flow in channel, Geometrical properties of channel section, velocity distribution in open channel, Velocity and pressure distribution, continuity equation.

UNIT 2 Uniform flow in channel: Chezy"s equation, Manning"s formula, Manning"s roughness coefficients, Equivalent roughness, Hydraulically efficient different channel sections, Computation of uniform flow.

UNIT 3 Energy depth relationships: Specific energy, critical depth, concept of specific force, alternate depths, specific energy diagram, Application of momentum principle problems like hydraulic jump, properties of jumps.

UNIT 4: Gradually varied flow: Introduction, Differential equation of GVF, Different types of flow profile, flumes and its application. **Rapidly varied flow:** Introduction, Sharp-crested weir, Ogee spillway, sluice gate flow. **Dimensional analysis:** Dimensions and units, Non-dimensional numbers, Bunkingham"s Pi-theorem and its application, principles of similitude and its application to practical problems, model study.

UNIT 5 Hydraulic Machines: Introduction, Dynamics forces on curved and bends, Elements of hydroelectric power plants, head and efficiencies of hydraulic turbines, classification of turbines, Pelton wheel turbine, working proportions of Pelton wheel, DESIGN OF Pelton wheel runner, study and design Francis turbine, Draft tube theory, Kaplan turbine, working proportions of Kaplan turbine, Efficiency, specific speed and unit quantities, centrifugal and reciprocating pumps.

B.TECH. V Semester Examination
CE 303 Environmental Engineering I

L	T	P	Credits
3	1	0	4C

UNIT 1 General: Environment and its components, Importance of water. Role of an Environmental Engineer. Historical overview. **Water Demand:** Various types of water demands, Factors affecting per capita demand, Variations in water demand, design periods and population forecasts. Design capacities for various water supply components.

UNIT 2 Sources of Water: Surface and sub-sources of water. Assessment of yield and storage capacity of reservoir. **Development of Ground Water:** Factors governing occurrence of groundwater, various forms of underground sources and their exploitation. Types of wells, Tube wells & their types, Yield of Wells, Comparison of surface & groundwater sources.

UNIT 3 Intakes for collecting surface water: Intakes /Definition & Introduction. Factors governing the location of intake. Types of Intakes. Design of intake works. **Transmission of water:** Hydraulics of conduits. Forces acting on pressure conduits. Selection of pipe materials. Types of points, Corrosion of metal pipes & its control. Pipe appetencies, various types of pumps for lifting water, factors affecting selection of pump, Design of pumping stations.

UNIT 4 Quality of water: Physical, Chemical and Bacterial & Microscopical characteristics of water, water Borne Diseases & their control, Quality standards for municipal & domestic supplies. **Treatment of water:** Water treatment processes (theory & application). Plain sedimentation, sedimentation aided with coagulation, Filtration, Disinfections, Aeration, Softening, Miscellaneous treatment processes such as fluoridation, re carbonation, liming, desalination etc.

UNIT 5 Distribution of water: Requirements of good distribution system. Layout of distribution networks, Methods of distribution. Systems of supply. Distribution reservoirs-functions, types & storage capacity of distribution reservoirs.

References

1. Peavy, H. S., Rowe, D. R. and Tachobanoglous, G., "Environmental Engineering", McGraw Hill Book Company.
2. Garg, S. K., "Water Supply Engineering", Khanna Publishers.

B.TECH. V Semester Examination
CE 304- Structural Analysis II

L	T	P	Credits
3	1	0	4C

UNIT 1: Analysis of Fixed Beams, Continuous Beams and Simple Frames with and without translation of joints, method of consistent deformation, slope deflection method, moment distribution method, strain energy method

UNIT 2 Muller Breslau"s principle and its application for drawing Influence lines for indeterminate beams

UNIT 3 Analysis of two hinged arches, influence line diagrams for max. BM, shear force and thrust.

UNIT 4 Suspension Bridges, analysis of cables with concentrated and continuous loading, basics of two and three hinged stiffening girders, influence line diagram for BM, SF in stiffening girders

UNIT 5 Basics of force and displacement matrix methods for beams, plane frames(rigid and pin-jointed), Basics of Plastic analysis, application of static and kinematic theorem for plastic analysis of beams and plane frames

B. TECH. V Semester Examination
CE 305 Water Resources Engineering

L	T	P	Credits
3	1	0	4C

UNIT 1 Introduction: Definition, Necessity, Scope of irrigation science, benefits of irrigation, types of irrigation, Scope of irrigation, multi-purpose river valley projects, soil moisture and crop water relations, consumptive use of water, ill effects of irrigation, principal Indian crop seasons and water requirements, water requirements of crops. **Surface water sources and storage reservoirs:** Ponds and lakes as surface sources, stream and rivers, types of reservoirs, capacity elevation curves of a river reservoirs, catchment yield and reservoir yield, reservoirs losses, reservoir clearance.

UNIT 2 Canal irrigation: Introduction, types of canal, parts of canal irrigation system, assessment of water requirements, estimation of channel losses, design of channels, regime and semi-theoretical approaches (Kennedy"s theory and Lacey"s theory). **Canal outlets:** Introduction, types of outlets, Non-modular outlets, pipe outlets, Semi-module or flexible outlets, rigid outlets. **Principles of design of masonry and other structures for canals:** Design of weirs and barrage by Bligh"s and Khosla"s methods, types of falls, design of falls, cross drainage works, energy dissipation. Design of diversion head works.

UNIT 3 Well irrigation: Introduction, Division of sub-surface water, types of aquifer, storage coefficient, well hydraulics, advantages and disadvantages of well irrigation over canal irrigation. **Hydrology:** Definition, hydrologic cycle, measurement of rainfall, , rain gauge, peak flow, flood frequency, flood hydrograph, rainfall analysis, infiltration, runoff, unit hydrograph and its determination, estimation of runoff.

UNIT 4: Regulation works: Falls, classification of falls, design of falls, distributory head regulator, cross-head regulator, escape. **Cross-Drainage structures:** Necessity of cross-drainage structures, their types and selection, comparative merits and demerits, design of various types of cross-drainage structures like aqueduct, siphon aqueduct, superpassage, level crossing.

UNIT 5: Diversion Headworks: Selection of site and layout, different parts of diversion headworks, types of weirs and barrages, design of weirs on permeable foundation, silt excluders and different types of silt ejectors. **Dams:** Introduction, suitable sites, forces acting on a gravity dam, stability requirements, principles of design of gravity dams, mass concreting of dams. **Spillways:** Introduction, types of spillways, design of spillways, energy dissipation below spillways.

B.TECH. V Semester Examination
CE 306: Geotechnical Engineering Laboratory – I

L	T	P	Credits
0	0	2	2C

Based on course contents of CE 301.

B.TECH. V Semester Examination
CE 307: Hydraulics and Hydraulic Machines Lab.

L	T	P	Credits
0	0	2	2C

Based on course contents of CE 302

B.TECH. V Semester Examination
CE 308 Environmental Engineering Lab

L	T	P	Credits
0	0	2	2C

List of Experiments (new experiments may also be designed)

1. Determination of pH, Temp, Total dissolved solids (TDS), conductivity and salinity of giver sample of water.
2. Determination of acidity and alkalinity of water sample.
3. Determination of harness.
4. Determination of chlorides
5. Determination of total residual chloride.
6. Determination of dissolved oxygen (DO)
7. Determination of turbidity.
8. Determination of Most Probable Number (MPN) and coliforms.
9. Determination of fluoride content.
10. Determination of B.O.D of sewage.
11. Determination of C.O.D of sewage.
12. Determination of total suspended solids.
13. Determination of volatile and fixed solids.
14. Determination of optimum dose of coagulants.
15. Determination of T.O.C
16. Determination of nitrogen.
17. Determination of heavy metals in sewage sample like Zn, Cd, Ni, Pb, Fe etc.

B.TECH. V Semester Examination
CE 309-Minor Project - I

L	T	P	Credits
0	0	2	2C

B.TECH. V Semester Examination
CE- 310 Survey Camp Evaluation

L	T	P	Credits
0	0	2	2M

Evaluation based on the work done during the survey camp held in the summer break after fourth semester

SIXTH SEMESTER

B.TECH. VI Semester Examination
CE 311- Design of Steel Structure

L	T	P	Credits
3	1	0	4C

UNIT 1 Design of plate girders with stiffeners in unbuckled and buckled state, splicing of web and flange components using different type of connections.

UNIT 2 Corrosion protection, fire resistant design and design of beam column connections. Design of roof trusses and industrial buildings.

UNIT 3 Fatigue resistant design of steel structures. Design of steel bridges.

UNIT 4 Design of beam-column. Design of gantry girders.

UNIT 5 Design of transmission line towers. Design of steel tanks, silos and stacks.

B.TECH. VI Semester Examination
CE- 312 Environmental Engineering II

L	T	P	Credits
3	1	0	4C

UNIT 1 **Sewerage:** Systems of sanitation. Types of sewage and sewerage systems. Components of sewerage system. Design periods and future forecasts. Variations in sewage flow and their effection design of various components of a sewerage system. Estimation of peak drainage discharge. Systems of sewerage- separate, combined and partially system. Components of sewerage system, layout of sewerage system. Shapes of sewer. Hydraulic design of sewers and storm water drain sections. Construction and testing of sewer lines. Sewer materials. Sewer joints & appurtenances, sewage pumping and pumping stations. Maintenance of sewerage system.

UNIT 2 **Sewage Characteristics:** Physical, Chemical and Biological characteristics of sewage, Disposal of sewage into natural water course on land. Indian standards for the disposal of sewage, Self purification in natural streams. Zones of pollution in natural stream, Disposal of sewage in lakes and management if lake waters, Disposal of sewage in sea water, Sewage farming, sewage sickness.

UNIT 3 **Sewage Treatment-I:** Preliminary treatment, primary treatment, secondary treatment and tertiary treatment of sewage. Screening- Method, types of screens, their design & cleaning, Disposal of screenings. Grit Chambers- Function of girt chambers, Types of grit chambers, Constant velocity grit chambers, Parabolic shaped grit chambers, Aerated grit chambers, Detritus tanks, skimming tanks, Valuators, Disposal of skimmings, Necessity & use of skimming tanks in India.

UNIT 4 **Sewage Treatment-II:** Sedimentation- Necessity, Construction & design of sedimentation tanks, Sedimentation aided with coagulation. Biological Treatment- Contact beds, intermittent sand filters, Trickling filters- Construction, operation a& design. High rate trickling filters, Activated sludge process, oxidation pond, oxidation ditch, septic tanks, soak pits, Imhoff tanks.

UNIT 5 **Sewage Treatment-III:** Sludge Digestion-Sludge & its moisture content, sludge digestion process, factors affecting sludge digestion and their control sludge digesters-Constructional details and design considerations, Disposal of digested sludge.

References

1. Peavy, H. S., Rowe, D. R. and Tachobanoglous, G., "Environmental Engineering", McGraw Hill Book Company.
2. Garg, S. K., "Sewage Disposed and Air Pollution Engineering", Khanna Publishers.

B.TECH. VI Semester Examination
CE 313: Geotechnical Engineering – II

L	T	P	Credits
3	1	0	4C

UNIT 1 Soil Exploration: Purpose; Planning and reconnaissance; Various methods; Bore holes and depth of exploration; Sampling and samplers; Standard penetration test; Coorelations between penetration resistance and strength parameters; Static cone test; Dynamic cone test; Plate Load test; Interpretation of test results; Indirect methods of soil exploration.

UNIT 2 Earth Pressures and Retaining Structures: Lateral earth pressure problems; Plastic equlibrium in soils, active and passive states; Earth pressure at rest; Rankine˝s theory of active and passive earth pressures; Active and passive earth pressure of cohesive soils; Coulomb˝s earth pressure theory; Graphical constructions to evaluate earth pressures; effect of surcharge and earthquake loading; earth pressure due to inclinesd backfills; Stability Analysis of retaining walls, choice of backfill material and importance of drainage; Bracings for open cuts, recommended design diagrams of earth pressure for typical soils; Earth pressure on cantilever and anchored sheet pile walls; Arching and its practical implications.

UNIT 3 Stability of Slopes: Factor of safety; Stability of infinite slopes; Stability of finite slopes; The Swedish circle method; Bishop˝s simlified method; Friction circle method; Taylor˝s stability number; Acceptable values of factor of safety; Critical conditions for the stability of earth dams; Road and earth dam embankments; Modes of failure and the usual protective measures; Slope inclinations usually adopted.

UNIT 4 Shallow Foundations: Common types with illustrations of situations where each one of them is adopted; Terminology; Rankine˝s analysis; Terzaghi˝s bearing capacity theory; Types of failures; Bearing capacity computations in cohesionless and cohesive soils; General bearing capacity equation, Meyerhof˝s analysis, Effect of water table on bearing capacity; Bearing capacity on layered soil; Use of field test data; Foundation settlements; Components and limits of settlemernts; Estimation of settlement of footings / rafts by using field and laboratory test data; Corrections for rigidity and 3-dimensional consolidation effects. **Pile Foundations:** Classification and uses of piles; Selection and installation of piles; Load carrying capacity of piles, dynamic and static formulae; Single pile and group actions; Pile load tests; Negative skin friction, Settlement of pile groups; Laterally loaded piles.

UNIT 5 Well Foundations: Situations where adopted; Types of wells or caissons; Elements of wells; Methods of construction; Tilt and shifts; Remedial measures; Depth and size of wells on the basis of scour depth; Bearing capacity and settlement; Terzaghi˝s lateral stability analysis. **Introduction to Machine Foundations:** Types of machines and their foundations; Terminology; Design critaria; Field methods of determining design parameters-Cyclic plate load test; Block vibration test; Response of block foundations under vertical vibrations. **Foundation on Expansive Soils:** Identification of expansive soil; problems associated with expansive soils; Design considerations of foundations on expansive soils; Under-reamed piles.

B.TECH. VI Semester Examination
CE 314 Transportation Engineering I

L	T	P	Credits
3	1	0	4C

UNIT 1 Introduction: Modes of Transportation, their importance and limitations. **Highway Planning:** Principles of Highway Planning, Road development and Financing, Privatization of Highways, Highway Alignment-Requirements, Engineering surveys for Highway Alignment.

UNIT 2 Geometric Design: Cross section elements, Requirements of sight distances and design of horizontal and vertical alignments.

UNIT 3 **Highway Materials:** Properties pavement component materials, Tests on subgrade soil, aggregates and bituminous materials, Bituminous mix design.

UNIT 4 **Pavement Design and Construction:** Types of pavements, Factors in the design of flexible and rigid pavement, Group index and C.B.R. Methods, Westergards analysis of wheel load stresses in rigid pavement, I.R.C. design method for concrete pavements. Pavement Construction Techniques and Quality Control. **Highway Drainage:** Surface drainage and subsoil drainage, Pavement failures, Maintenance and Strengthening.

UNIT 5 **Traffic Engineering:** Fundamentals of Traffic Flow, Traffic studies and their uses, Traffic control devices, Traffic Management, Prevention of Road accidents, Concept of Intelligent Transportation system.

References

1. Khanna, S. K. amd Justo, CEG, "Highway Engineering", Nem Chand & Bros., 1997.
2. Kadiyali, L. R., "Highway Engineering", Khanna Publishers, Delhi, 1996.

B.TECH. VI Semester Examination
CE 315 Estimation, Costing and Work Procedures

L	T	P	Credits
3	1	0	4C

UNIT 1 **Introduction,** Procedure of estimating of different items of work, units of measurements. Methods of building estimates. Estimation of simple buildings. Estimation of different types of roofs.

UNIT 2 **Estimation of Different Types of works:** RCC works and structures; Sanitary and water supply works; culverts, bridges and wells; irrigation works; Road estimation.

UNIT 3 **Types of Estimates:** Preliminary, Approximate, Abstract, Plinth area, Cube rate, Detailed, Revised, and Supplementry estimates. Contingencies, Work charge establishments, Tools and plants, Centage, Site Plan, Layout plan, Index Plan, Electrification, Sub-heads, Schedule of rates, Admionistrative approval, Expenditure sanction, Bill of quantities, Day work, prime cost, Quantity survey. Plinth area, Floor area, Circulation area, Carpet area, External services, Capital cost. Analysis of rates of various building works, sanitary and water supply works, Transport of materials.

UNIT 4 **Specifications:** Detailed specifications of different items of work in building. Road specifications. Valuation, Scrap value, salvage value, Obsolescence, Annuity, Capitalised value, Sinking fund, Depreciation, mortgage, life of various items of works.

UNIT 5 **Procedure of Works:** Classification of works; repair works; Contract, Tender, Tender Notice; Earnest money, Security money. Work order, Conditions of Termination, Daily Labour, Muster roll, Peace Work Agreement. Lumpsum and Schedule Contract, Conditions of contract, Contract Document, Labour contract, Penalty, Liquidated damages, Extension of time, termination of contract.

References

1. Dutta, B. N. *Estimating and Costing in Civil Engineering*, UBSPD New Delhi.

B.TECH. VI Semester Examination
CE 316 Geotechnical Engineering Laboratory – II

L	T	P	Credits
0	0	2	2C

Based on course contents of CE 313.

B.TECH. VI Semester Examination
CE 317: Transportation Engineering Lab

L	T	P	Credits
0	0	2	2C

List of Experiments (new experiments may also be designed)

1. CBR test on soil
2. Impact test on aggregates.
3. Crushing test on aggregates.
4. Los Angles Abrasion test on aggregates.
5. Soundness test on aggregates.
6. Shape test on aggregates.
7. Specific gravity on aggregates.
8. Penetration test on bitumen.
9. Ductility test on bitumen.
10. Softening point test on aggregates.
11. Viscosity test on Tar.
12. Flash and fire point on bitumen.
13. Specific gravity test on bitumen.
14. Traffic speed study (Enoscope method)
15. Traffic volume study (Manual as well as mechanical method).

B.TECH. VI Semester Examination
CE 318 Minor project – II

L	T	P	Credits
0	0	4	4C

B.TECH. VI Semester Examination
CE 319: Industrial Training - I

L	T	P	Credits
0	0	2	2C

SEVENTH SEMESTER

B.TECH. VII Semester Examination
CE 401- Design of Concrete Structure

L	T	P	Credits
3	1	0	4C

UNIT 1 Slabs, Lintels and Staircases: design of one way and two way slabs, circular slabs, flat slabs, yield line theory for slabs, beam and slab construction, lintels and staircase

UNIT 2 Torsion: Design of continuous & curved beam s. Column footing: Isolated and combined column footing

UNIT 3 Retaining wall: Design of cantilever & counter-fort type retaining wall.

UNIT 4 Introduction to folded plates and shells.

UNIT 5 Multi-storeyed building frames: Analysis by approximate method, design and detailing, IS specifications and loading standards. Water tanks and towers: Design of rectangular, circular, and Intze type tanks, column brace type staging and circular raft foundation

References:

1. Gray, W.S. and Mannings GI "Reinforced concrete water towers", bunkers, silos and gantries", concrete publication limited.
2. Reynolds, C.E. and Steadman, J.C. "Reinforced concrete design hand book", cement and concrete association, London.
3. Dayaratnam, P., "Reinforced concrete structures" Oxford and IBH Publishing Co.
4. Sinha, S.N., " Reinforced concrete design" , Tata McGraw Hill Publishing Co., New Delhi.
5. Krishna, J. and Jain, O.P., "Plain and Reinforced Concrete", Vol-I Nem Chand and Bros. Roorkee.
6. Jain, A.K., " Reinforced concrete – limit state design", Nem Chand and Bros. Roorkee.
7. Syal, I.C and Ummat, R.K. "Analysis and design of reinforced concrete elements", A.H. Wheeler and Co. Ltd., Allahabad.

B.TECH. VII Semester Examination
CE 402 Transportation Engineering II

L	T	P	Credits
3	1	0	4C

UNIT 1 **Introduction:** History of Indian Railways, Role of Railways, Gauge. **Permanent Way Component Parts:** Types of rail sections, Welding of rails, SWR and LWR sleepers requirements and types. Wheel and axle arrangements, Coning of wheels, various resistances and their evaluation, hauling capacity and tractive effort, stresses in rail, sleepers, ballast and formation. Rail fittings, bearing plates, anti-creep devices, check and guard rails. Ballast requirements, Specifications, Formation, cross section, drainage.

UNIT 2 **Geometric Design:** Alignment, horizontal curves, super elevation, equilibrium cant and cant deficiency, Length of transition curves, Gradients and grade compensation, vertical curves. **Points and Crossing:** Design of simple turn out, various types of track junction and their configurations.

UNIT 3 **Signalling and Interlocking:** Control of train movements and monitoring, types of signals, principle of interlocking, Modernization of railways and railway tracks, High speed tracks. **Air Transport Development:** Airport scenario in India-Stages of development, Aircraft Characteristics, airport planning, site selection. Obstruction and Zoning Laws, Imaginary surfaces, Approach Zones and Turning Zones.

UNIT 4 **Runway and Taxiway Design:** Elements of runway, orientation and configuration, Basic runway length and corrections, Geometric design elements. Taxiway design, Main and exit Taxiways. Separation clearance, Holding aprons, Typical airport layouts. Terminal building, gate position. **Visual Aids and Air Traffic Control:** Airport marking and lighting, Airway and airport traffic control, Instrumental landing systems and other air navigation aids.

UNIT 5 **Harbours:** Types of harbours, Size and accessibility, Tides, wind and wave, Dynamic effect of wave action, Breakwaters and their classification, mound construction. **Docks:** Types of Docks, shape and size, Caissons for dock entrances, Floating docks and their design considerations.

References

1. Aggarwal, M. M., "Railway Engineering", Student Edition, Prabha & Co., New Delhi.

2. Saxena, S. C. and Arora, S. P., "A Text Book of Railway Engineering", Dhanpat Rai & Sons.
3. Mundrey, J. S., "Railway Track Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delh.
4. Track Manuals of Indian Railways.
5. Indian Railways Permanent Way Manual.

B.TECH. VII Semester Examination
CE:403 Construction Technology and Management

L	T	P	Credits
3	1	0	4C

UNIT 1 Introduction: Objectives and functions of project management, Finance and cost accounting, Quality control, Methods of motivation and incentives.

UNIT 2 Network Techniques: Introduction to CPM/PERT methods and their use in construction planning, preparation of construction schedules for jobs, materials, equipments, labour and funds and project monitoring.

UNIT 3 Construction Equipments: Different types of construction equipments viz., earth moving equipments, dewatering and pumping equipments, grouting equipments, pile driving equipments and other construction equipments such as conveyors, cranes, concrete mixers, vibrators, road construction machinery, rollers, compactors etc. Factors affecting the selection of construction equipments.

UNIT 4 Equipment Management: Productivity, operational cost, owing and hiring cost and the work motion study.

UNIT 5 Contract Management: Legal aspects f contraction, laws related to contracts, land acquisition, labour afety and welfare. Different types of contracts, their relatives advantages and disadvantages. Elements of tender operation, prequalificat6ions of contracts, Evaluation of tenders, Contract negotiation and award of works, settlement of disputes, arbitration and commissioning of the project.

References

1. Sreenath L. S., "PERT and CPM", Affiliated East West Press, New Delhi.
2. Punmia B. C., and Khandelwal K. K., "PERT and CPM", Laxmi Pub., New Delhi.
3. Peurifoy R. L., "Construction Planning, Equipments and Methods", McGraw Hill Book Co., Inc., New York.
4. Verma Mahesh, "Construction Planning and Management", Delhi Metropoliton.
5. R. L. Peurify, "Construction Planning : Equipments and Methods", Tata McGraw Hill, Inc.
6. Satyanarayanan & Saxena, Construction Planning and Equipment", Standard Publishers Distributors, New Delhi.

B.TECH. VII Semester Examination
Elective 1

L	T	P	Credits
3	1	0	4C

Students to choose one elective from the list of Elective – I.

B.TECH. VII Semester Examination
CE 404: Estimation and Evaluation

L T P	Credits
1 0 2	3C

Practical Examination based on

1. Building Drawing
2. Quantity Estimation
3. Drawing Estimation
4. Analysis of rates
5. Valuation

References:

1. Dutta B. N. "Estimating and costing in civil engineering- Theory and practice" UBS Publishers distributers Ltd., New Delhi, 1994.
2. Goyal S. C. and Jain O. P. "Manual of Estimating" Nemchand and Bros., Roorkee (UP), 1960.
3. Shah MG, Kale CM and Patki SY "Building Drawing" TataMcGraw Hill Publishing Co. Ltd., 2nd edition New Delhi, 1985.

B.TECH. VII Semester Examination
CE 405: Concrete Design Laboratory

L T P	Credits
0 0 3	3C

Based on the course work of Concrete Structures.

B.TECH. VII Semester Examination
CE 406: Industrial Training - II

L T P	Credits
0 0 4	4M

B.TECH. VII Semester Examination
CE 407: Major Project Part - I

L T P	Credits
0 0 4	4M

EIGHTH SEMESTER

B.TECH. VIII Semester Examination
CE 411: Prestressed Concrete

L T P	Credits
4 0 0	4C

UNIT 1: Introduction, Advantages and Types of Prestressing, Pre-tensioning Systems and Devices, Post-tensioning Systems and Devices, Concrete properties, Prestressing Steel, Losses in Prestress in pre and post tensioned members.

UNIT 2 Analysis of Members under Axial Load. Analysis of Member under Flexure. Design of Members: Design of Sections for Flexure , Detailing Requirements for Flexure.

UNIT 3 Analysis for Shear, Design for Shear, Analysis for Torsion, Design for Torsion.

UNIT 4 Calculation of Deflection, Calculation of Crack Width, Transmission of Prestress in pre and post tensioned members.

UNIT 5 Cantilever Beams, Continuous Beams, Composite Sections, One-way Slabs, Two-way Slabs, Compression Members, Circular Prestressing.

B.TECH. VIII Semester Examination
Elective – II

L	T	P	Credits
4	0	0	4C

Students to choose one elective from the list of Elective – II.

B.TECH. VIII Semester Examination
Elective – III (Open)

L	T	P	Credits
4	0	0	4A/H

Students to choose one elective from the list of Open Electives offered by various Departments

B.TECH. VIII Semester Examination
Elective – II Laboratory

L	T	P	Credits
0	0	3	3C

Course work based on Elective – II.

B.TECH. VIII Semester Examination
Elective – III (Open) Laboratory

L	T	P	Credits
0	0	3	3A/H

Course work based on Elective – III (Open).

B.TECH. VIII Semester Examination
CE 412: Project Part – II

L	T	P	Credits
0	0	10	10M

B.TECH. VIII Semester Examination
CE 413: Seminar

L	T	P	Credits
0	0	2	2M

Elective – I

CE 4101	Advanced Theory of Structures
CE 4102	Seismic Design of Structures
CE 4103	Soil Structure Interaction
CE 4104	Rock Mechanics
CE 4105	Structural Dynamics
CE 4106	Design of Hydraulic Structures
CE 4107	Geotechnical Earthquake Engineering
CE 4108	Earth and Earth Retaining Structures
CE 4109	Environmental Impact Assessment and Audit
CE 4110	Solid Waste Management

CE 4101 Advanced Theory of Structures

Flexibility and stiffness methods of structural analysis, Analysis using substructure technique, effects of axial forces on flexural stiffness, Analysis of framed shear wall buildings, Non Linear and Elasto-Plastic Analysis, Beams curved in plan and elevation, Various types of structural systems for tall buildings.

References:

1. H.C.Martin," Introduction to Matrix Methods of Structural Analysis.
2. Kardestuncer, "Elementary Matrix Analysis of Structures"
3. Weaver & Gere "Matrix Structural Analysis", CBS Publisher
4. A.Gahali, A.M. Neville & Brown "Structural analysis"
5. Norris , Wilbur, Utku " Elementry Structural analysis"
6. Beaufait,Rowan,Hoadley "Computer method of Structural analysis

CE 4102 Seismic Design of Structures

UNIT 1 INTRODUCTION: Elements of engineering Seismology - Theory of Vibration - Response Spectrum.. Indian Seismicity-Earthquake history - Behaviour of structures in the past Earthquakes.

UNIT 2 DESIGN CONCEPTS: Seismic Design Concepts – Cyclic load Behavior of RC, Steel & Prestressed Concrete Element - Design Spectrum – Principles of Capacity Design.

UNIT 3 CODAL PROVISIONS: Provisions of Seismic Code (IS 1893,IS4326) – Building systems Frames, Shear Walls, Braced frames, Combinations- Torsion.

UNIT 4 DESIGN & DETAILING: Performance of Regular Buildings 3D Computer Analysis of Building Systems (Theory Only) – Design & Detailing of frames – Shear Walls –Frame walls.

UNIT 5 SPECIAL PROBLEMS & CASE STUDIES: Structural Configuration – Seismic performance-Irregular Buildings- Soil Performance-,Modern Concepts – Base Isolation – Adoptive System – Case Studies.

References:

1. *Course Notes "Design of Reinforced Concrete Building, IIT Kanpur, June 1999.*

2. *Bungale S.Taranath "Structure Analysis & Design of Tall Buildings" Mcgraw Hill Book Company, Newyork, 1999.*
3. Mark Fintel "Handbook of concrete engg." CBS

CE 4103 Soil Structure Interaction

UNIT 1 SOIL FOUNDATION INTERACTION: Introduction to soil foundation interaction problems, Soil Behaviour, Foundation Behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic Continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

UNIT 2 BEAM ON ELASTIC FOUNDATION – SOIL MODELS: Infinite beam, Two Parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT 3 PLATE ON ELASTIC MEDIUM: Infinite Plate, Winkler, Two parameters, Isotropic elastic medium, Thin & Thick plates, Analysis of finite plates, rectangular & circular plates, Numerical analysis of finite plates, simple solutions.

UNIT 4 ELASTIC ANALYSIS OF PILE: Elastic analysis of single pile, Theoretical solution for settlement & Load Distributions, Analysis of Pile Group, Interaction Analysis, Load Distribution in groups with Rigid Cap.

UNIT 5 LATERALLY LOADED PILE: Load Deflection Prediction for Laterally loaded piles, Sub-grade reaction & Elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts.

References:

1. *Selva durai, A.P.S., Elastic analysis of Soil Foundation Interaction, Elsevier, 1979.*
2. *Poulos, H.G., & Davis, E.H., Pile Foundation Analysis & Design, John Wiley, 1980.*
3. *Scott, R.F., Foundation Analysis, Prentice Hall, 1981.*
4. *Structure Soil Interaction-State of Art Report, Institution of Structure Engineers, 1978.*
5. *ACI 336, Suggested Analysis and Design Procedure for Combined Footings & Mats, American Concrete Institute, Delhi, 1988.*
6. *S.P. Timoshenko, S.W., Krieger, 'Theory of Plates and Shells, McGraw-Hill, 1959*
7. *S.P. Timoshenko, Strength of material, CBS Publisher.*
8. *Bowles "Foundation analysis and design" McGrawHill*

CE 4104 Rock Mechanics

Introduction ; problems of rock mechanics; classifications of rock masses; rock exploration – rock coring, geophysical methods; laboratory testing of rocks; fraction in rocks; elasticity & strength of rocks; strength & failure of rocks; Griffith"s theory, Coulomb"s theory, in-situ tests on rock mass; deformation characteristics, instrumentation and measurement of deformation of rocks; permeability. Mechanical, thermal and electrical properties of rock mass; openings in rock mass and stresses around openings; slope stability; pressure tunnels, development of plastic zone; rock support needed to avoid plastic deformation; lined and unlined tunnels; support pressure and slip of the joint; underground excavation and subsidence; foundation on rocks; bearing capacity of intact and jointed rocks; rock slopes; rock bolt anchors & grouting; underground openings, pillars, tunnels, methods of construction; problems associated with tunnels, tunnelling in various subsoil conditions and rocks.

CE 4105 Structural Dynamics

Oscillatory motion; harmonic motion, periodic motion, vibration terminology, Characteristics of a Dynamic Problem, Prescribed Dynamic Loading, Definition of Dynamic DOFs, Mathematical modeling of dynamic systems, , Formulation of Equations of motion in Generalized SDOF, SDOF, MDOF discrete and continuous systems using d"Alembert"s Principle, Principle of Virtual displacements and Variational Approach.

Free vibration; equations of motion-natural frequency, Experimental determination of natural frequencies, viscously damped free vibration, Coulomb damping, Response of SDOF system to harmonic, periodic, impulsive and general dynamic loading, earthquake excitations in time and frequency domain. Base excited systems. Transmissibility and Vibration isolation, Laplace transform formulation, energy dissipated by damping, equivalent viscous damping, structural damping, vibration measuring instruments.

Free Vibration response of discrete MDOF systems, eigen values, eigen vectors. Approximate methods for obtaining natural frequencies and mode shapes, Forced Harmonic Vibration, vibration absorber, vibration damper. Damping in structures.

Free and Forced vibration of continuous systems.

Concept of Spectral quantities, response spectrum, Discussion on IS 1893: part I 2000 codal provisions, Response of linearly elastic systems using modal analysis.

References:

1. W.T.Thomson, "Theory of Vibration with Applications" ;Pearson Education
2. R.W. Clough & J.Penzien, "Dynamics of Structures", McGraw Hill
3. J.L.Humar " Dynamics of Structure" Prantice Hall
4. J.W. Smith , " Structural Dynamics"
5. A.K. Chopra, "Dynamics of Structures : Theory and Application to Earthquake Engineering", Prantice Hall India
6. Mario Paz, " Structural Dynamics theory and Computations" , CBS Publishers.
7. Roy L. Craig, " Structural dynamics: Introduction to Computational methods", John Wiley
8. Meiroritch "Fundamentals of variable" Mc Graw Hall
9. Jaikrashna " Element of earthquake engg." South asia publishers pvt. Ltd.
10. Hurty and Rubinsion "Dynamics of structures" PHI

CE 4106 Design of Hydraulic Structures

UNIT 1 Project planning of hydraulic structure, site investigation and chose of type of hydraulic structures.
UNIT 2 Different types of dam, their design, stress analysis, stress concentration around openings.
UNIT 3 Different types of spillway and energy dissipaters, their design and analysis. Model analysis of hydraulic structures.
UNIT 4 Design of weirs and barrages and analysis.

CE 4107 Geotechnical Earthquake Engineering

Introduction to engineering seismology, seismic risks and hazards, causes and strength of earthquakes, social and economic consequences, theory of dynamic and seismic response, the nature and attenuation of earthquake magnitude, ground motion, determination of site characteristics, local geology and soil condition, determination of design earthquake, response spectra and accelerograms. Site response to earthquake site investigation and soil test; dynamic behaviour of soils, liquefaction phenomena, analysis of pore pressure development, laboratory and in-situ testing for liquefaction, analysis and design of slopes, embankments, seismic response of soil structure system, shallow foundation, pile foundation, foundations and earth retaining structures for seismic loading, case histories, mitigation techniques

CE 4108 Earth and Earth Retaining Structures

Earth pressure theories; Rankine's theory; Coulomb's theory; graphical techniques & analytical methods; rigid retaining structures types; empirical methods; stability analysis. Flexible retaining structures types; material; cantilever sheet piles; anchored bulkheads – free earth method, fixed earth method, moment reduction factors, anchorage. Braced excavation: types; construction methods; pressure distribution in sands and clays; stability - bottom heave, seepage, ground deformation. Reinforced soil walls: elements; construction methods; external stability; internal stability. Arching action, underground structures in soils: pipes; conduits; trenchless technology; tunnelling techniques - cut-and-cover method, shield tunnelling. Stability of slopes, analysis of earth & rock fill dam.

CE 4109 Environmental Impact Assessment and Audit

Environmental Impact Assessment – Definition, Objectives, Types – Rapid and Comprehensive EIA, EIS, FONSI. Step-by-step procedure for conducting EIA and Limitations of EIA, Prevention of Significant Deterioration (PSD) Programme. Frame work of Impact assessment, scope and contents of EIA, methodologies and techniques of EIA. Attributes, Standards and Value functions. Public participation in EIA. Environmental Management Plan (EMP) and Disaster Management Plan (DMP). EIA Case Studies –Thermal Power Plant, Mining, Fertilizer, Construction Projects, Air port, Water and Wastewater Treatment Plants.

CE 4110 Solid Waste Management

Sources of solid waste, types of solid waste, methods of disposal of solid waste, recycle and reuse, problems in the management under Indian conditions.
Mechanical Transformation of solid wastes : screening, size reduction : various devices for size reduction, objectives.
Thermal Transformation of solid wastes : pyrolysis, incineration, gasification.
Ultimate disposal of solid wastes : Landfills : problems, location of landfills, leachate composition, management of leachate, landfill liners, landfill covers. Bio gas from landfills : computations of gas quantity and its management

Elective – II

CE 4201 Design of Tall Buildings
CE 4202 Groundwater and Seepage
CE 4203 Foundation Engineering
CE 4204 Environmental Geotechnology
CE 4205 Ground Improvement Technology
CE 4206 Soil Dynamics and Machine Foundations
CE 4207 Material Science & Technology
CE 4208 Environmental Planning and Management
CE 4209 Disaster Management
CE 4210 Town Planning and Architecture
CE 4211 Reliability Analysis

CE 4201 Design of Tall Buildings

UNIT 1 Design Criteria: Design philosophy, loading, sequential loading, materials- high performance concrete- fiber reinforced concrete- light weight concrete- design mixes.

UNIT 2 Loading and Movement: Gravity loading : dead and live load, method of live load reduction, impact, gravity loading, construction loads. Wind loading: static and dynamic approach, analytical and wind tunnel experimental method. Earthquake loading: Equivalent lateral force, model analysis, combination of loading working stress design, limit state design, plastic design.

UNIT 3 Behaviour of various structural systems Factor affecting growth, height and structural form, high rise behavior, rigid frames, braced frames, infilled frames, shear walls, coupled shear walls, walls-frames, tubular- braced and hybrid mega system.

UNIT 4 Analysis and Design Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major sub system interaction, analysis for member forces, drift and twist, computerized general three dimensional analysis. Structural elements: sectional shapes, properties and resisting capacity , design , deflection, cracking, prestressing, shear flow, design for deferential movement, creep and shrinkage effects, temperature effect and fire.

UNIT 5 Stability of tall buildings. Overall buckling analysis of frames, wall-frames, approximate methods, second order effects of gravity of loading,P-Delta analysis, translational, torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation.

References:

1. *Bungale S.Taranath "Structure Analysis & Design of Tall Buildings" Mcgraw Hill Book Company, Newyork.*
2. Mark Fintel "Handbook of concrete engg." CBS.
3. Council of tall building "Advances in tall building" CBS.

CE 4202 Groundwater and Seepage

Darcy"s law, General hydro-dynamic equations, flow nets in isotropic and anisotropic medium. Steady and unsteady flow through confined and unconfined aquifers, Schwartz-Christoffel transformation and its application for ground water flow and seepage problems. Numerical Techniques for solution of ground water flow.

Multiple well system, partially penetrating wells, image wells, mutual interference of wells.

Storage and exploration of ground water, Design, Construction and Maintainence of wells. Ground water recharge and run off. Water quality, budgeting, simulation of ground water basin. Application of remote sensing for ground water.

CE 4203 Foundation Engineering

Structures subjected to vertical and lateral loads, excavation, vertical cut, retaining walls, shallow foundation, flexible and rigid rafts, highway pavements, allowable bearing pressure, geo-technical investigation, interpretation from field tests, pile and cassion, group action of piles, pier, shafts in rock socket. Foundations subjected to dynamic loads, theory of vibrations, natural frequency of a soil foundation system. Elastic constant of soils, pressure bulb concept, permissible amplitude, various

considerations for machine foundation. Strength and deformation characteristics of granular media under dynamic loads. Liquefaction.

References:

1. *B.M. Das "Advanced Foundation Engineering", Brookes and Cole India.*
2. *J. Bowels " Foundation analysis" "McGrawHill Publishers.*
3. *Rao, NSVK, "Vibration analysis and foundation dynamics", A.H. Wheeler & Co., New Delhi, India.*

CE 4204 Environmental Geotechnology

Introduction; Sources of subsurface contamination, Mechanisms of Soil contamination; Physical-chemical and biological interactions in soils; Effect of contamination on geotechnical properties; Waste disposal on land: Types of landfills, Siting criteria; waste containment principles, Types of barrier materials; Planning and design aspects relating to waste disposal in landfills, in ash ponds and tailing ponds; Environmental monitoring around landfills; Detection, control and remediation of subsurface contamination, Various types of barrier systems; Reclamation of contaminated sites; Case Studies.

CE 4205 Ground Improvement Technology

Ground improvement: principles of ground improvement; mechanical modification;properties of compacted soil, compaction control tests, hydraulic modification; dewatering systems, filtration, drainage and seepage control with geosynthetics, preloading and vertical drains, electro kinetic dewatering, chemical modification; modification by admixtures, stabilization using industrial wastes, grouting, modification by inclusion and confinement; soil reinforcement, flexible geosynthetic sheet reinforcement, anchorage; reinforcement techniques, bearing capacity improvement, slope stability, erosion control, retaining walls and pavements. Soil stabilization: shallow stabilization with additives: lime, flyash, cement and other chemicals and bitumen; deep stabilization; sand column, stone column, sand drains, prefabricated drains, electro-osmosis, lime column; soil-lime column; grouting: permeation, compaction and jet; vibro-floatation, dynamic compaction, thermal, freezing; dewatering systems

CE 4206 Soil Dynamics and Machine Foundations

Introduction, fundamentals of vibrations, vibration of elementary systems-mass, spring, dashpot systems, various degrees of freedom, dynamic properties of geo-materials, propagation of wave in granular media; laboratory and field tests for evaluation of dynamic soil properties; analysis and design of foundations for hammers, reciprocating engines and turbo generators; dynamic stiffness of single

pile and pile groups; vibration isolation and damping; theories for vibration of foundations on elastic media; design procedures for foundations with dynamic load and construction features; elastic homogeneous half space solutions, lumped parameter solutions; large deformation problems : liquefaction of soils & cyclic mobility.

CE 4207 Material Science & Technology

Material Technology: Cements-properties. Aggregates, Admixtures, Properties of fresh and hardened concrete. Mixing, compacting, transporting and curing of concrete. Non-destructive testing, special types of concrete. Temperature control in mass concrete. Creep and Shrinkage phenomenon in concrete. Mix design. Behaviour of concrete combined stresses. Tests in cement, aggregates and concrete.

Material Science: Structure of materials, Bonding, Phase equilibrium. Mechanical properties. Theories of failure for combined static, creep and fatigue effects. Brittle and ductile fracture. Plastic deformations. Structural imperfections and dislocations. Strain hardening. Electric and magnetic properties of materials. Corrosion of materials and their prevention.

References:

Smith "Principal of material science and engg."
Nevilly "concrete technology"

CE 4208 Environmental Planning and Management

Environment and Sustainable Development - carrying capacity, relationship with quality of life, carrying capacity and resource utilization. Engineering Methodology in Planning and its Limitations – carrying capacity based short and long term regional planning. Environmental Protection - Economic development and social welfare consideration in socio economic developmental policies and planning. Total cost of development and environmental protection cost. Case studies on Regional carrying capacity. Engineering Economics – Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting. Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications. Environmental Audit – methods, procedure, reporting and case studies. Total Quality Management in environmental management and protection – ISO 9000, 14000 and 18000 series of standards.

CE 4209: Disaster Management

Unit-I Natural Hazards and Disasters: Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Types of Environmental hazards & Disasters: Natural hazards and Disasters, Volcanic Hazards/ Disasters, - Causes and distribution of Volcanoes, - Hazardous effects of volcanic eruptions, - Environmental impacts of volcanic eruptions, Earthquake Hazards/ disasters, - Causes of Earthquakes, - Distribution of earthquakes, - Hazardous effects of earthquakes, Earthquake Hazards in India, Human adjustment, perception & mitigation of earthquake, Cumulative atmospheric hazards/ disasters- Lightning, Hailstorms, Cyclones: - Tropical cyclones & Local storms, - Destruction by tropical cyclones & local storms (causes , distribution human adjustment, perception & mitigation), Cold waves, Heat waves, Floods, Causes of floods, Flood hazards in India, - Flood control measures (

Human adjustment, perception & mitigation), Droughts: - Impacts of droughts, - Drought hazards in India, - Drought control measures.

Unit-II Man induced hazards & Disasters: Mechanics & forms of Soil Erosion, - Factors & causes of Soil Erosion, Conservation measures of Soil Erosion, Chemical hazards/ disasters-- Release of toxic chemicals, nuclear explosion, Sedimentation processes, - Global Sedimentation problems, Regional Sedimentation problems, Sedimentation & Environmental problems, Corrective measures of 23 Erosion & Sedimentation, Biological hazards/ disasters, Population Explosion

Unit–III Emerging approaches in Disaster Management- Three Satges: 1. Pre- disaster stage (preparedness)-(a) Preparing hazard zonation maps, Predictability/ forcasting & warning, b) Preparing disaster preparedness plan, c) Land use zoning, d) Preparedness through (IEC) Information, education & Communication Pre-disaster stage (mitigation) Disaster resistant house construction, Population reduction in vulnerable areas, Awareness

2. Emergency Stage:- a) Rescue training for search & operation at national & regional level, b) Immediate relief, c) Assessment surveys 3. Post Disaster stage-Rehabilitation- a) Political Administrative Aspect, b) Social Aspect, c) Economic Aspect d) Environmental Aspect

Unit-IV Natural Disaster Reduction & Management: a) Provision of Immediate relief measures to disaster affected people, b) Prediction of Hazards & Disasters, c) Measures of adjustment to natural hazards Mitigation- discuss the work of following Institution-(a) Meteorological observatory, (b). Seismological observatory, (c). Volcanology institution, (d). Hydrology Laboratory, (e.) Industrial Safety inspectorate,(f). Institution of urban & regional planners, (g). Chambers of Architects, (h). Enginering Council, (i) National Standards Committee, Integrated Planning- Contingency management Preparedness :-a) Education on disasters, b) Community involvement, c) The adjustment of Human Population to Natural hazards & disasters, Role of Media, Application of Geographical Information System(GIS) in Disaster risk management

Unit–V A regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India, Ecological planning for sustainability & sustanable development in India-Sustainable rural development:A Remedy to Disasters, -Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National, Centres for Natural Disaster reduction

References:

1. Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997
2. Kates,B.I & White, G.F The Environment as Hazards, oxford, New York, 1978
3. R.B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000
4. H.K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003
5. R.B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994
6. A.S. Arya Action Plan For Earthquake,Disaster, Mitigation in V.K. Sharma (Ed)
7. Disaster Management IIPA Publication New Delhi, 1994
8. R.K. Bhandani: An overview on Natural & Man made Disaster & their Reduction, ,CSIR, New Delhi
9. M.C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management,IIPA, New Delhi, 2001

CE 4210 Town Planning and Architecture

CE 4211 Reliability Analysis

UNIT I - Concepts of statistical and perceived risk, Role of risk assessment in modern technological social and environment context Techniques of risk assessment. Application of probabilistic and Markov models in risk estimation, catastrophic failure models, hazard model and their application in civil engineering. Introduction to fuzzy theory in risk analysis, uncertainty in risk assessment and decision making under uncertainty and risk. Reliability concept: MTTF, MTBF bath tub curve, hazard rate and failure density functions, useful life of components, system measures (performance, effectiveness and worth).

UNIT II - System reliability of series, parallel and non-series – parallel system, reliability approximations and bound, reliability improvement component improvement and redundancy concept. Reliability Computation for ex from value distribution