

NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)

K.R.NAGAR, KOVILPATTI – 628 503

www.nec.edu.in

REGULATIONS – 2015 CURRICULUM & SYLLABUS

B.E. – CIVIL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

VISION

Producing outstanding Civil Engineering Professionals with human values to face future challenges.

MISSION

- To provide with excellent teaching and research ambience.
- To prepare student for leadership roles in civil engineering.
- To facilitate student with lifetime skills and human values.
- To collaborate with industries to meet the ever challenging environment.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

1. Will have a successful career in civil engineering.

2. Pursue advanced degrees in support of their chosen profession.

PROGRAM OUTCOMES (POs)

At the time of graduation graduates of our CIVIL programme are expected to have

1. An ability to apply fundamental knowledge of mathematics, science and civil engineering in real-world problems.
2. An ability to identify, formulate and provide solution for engineering problems.
3. An ability to design and evaluate the desired needs.
4. An ability to conduct test and interpret the results.
5. An ability to use the skills, modern tools and techniques.
6. An ability to analyze the local and global impact of civil engineering.
7. Awareness of environment, innovations and sustainable development.
8. An ability to display their professional responsibilities meeting ethical standards.
9. An ability to have an idea of contemporary issues and an ability to function on multidisciplinary teams.
10. An ability to communicate effectively both in written and oral.
11. Recognition of the need for and an ability to engage in professional development and life-long learning.

12. An ability to lead a project team for the successful completion.

PREAMBLE OF THE CURRICULUM & SYLLABI

The Curriculum and Syllabi under Regulations 2015 is designed keeping in mind the Outcome Based Education (OBE) and Choice Based Credit System (CBCS). The course content of each course shall be fixed in accordance with the Program Educational Objectives (PEOs), Program Outcomes (POs) and Course Outcomes (COs).

The CBCS enables the students to earn credits across programmes and provides flexibility for slow and fast learners in registering the required number of credits in a semester. The CBCS facilitates transfer of credits earned in different departments / Centers of other recognized / accredited universities or institutions of higher education in India and abroad either by studying directly or by online method.

The curriculum of **Civil Engineering programme** is designed with total number of credits **176 (133 for Lateral entry)** and shall have the following category of courses in the curriculum.

1. **Foundation courses**
 - a. **Common Foundation Courses (CFC)** include Mathematics, Basic Sciences, Engineering Sciences and Skill Based Courses.
 - b. **Specific Foundation Courses (SFC)** include the basic courses specific to a programme of study.
2. **Programme Core Courses (PCC)** include the core courses relevant to the chosen programme of study and the Employability Enhancement courses such as Project, Seminar and Inplant training/ Internship.
3. **Programme Elective Courses (PEC)** include the elective courses relevant to the chosen programme of study.

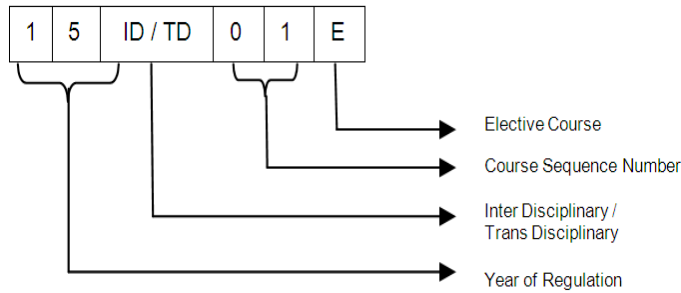
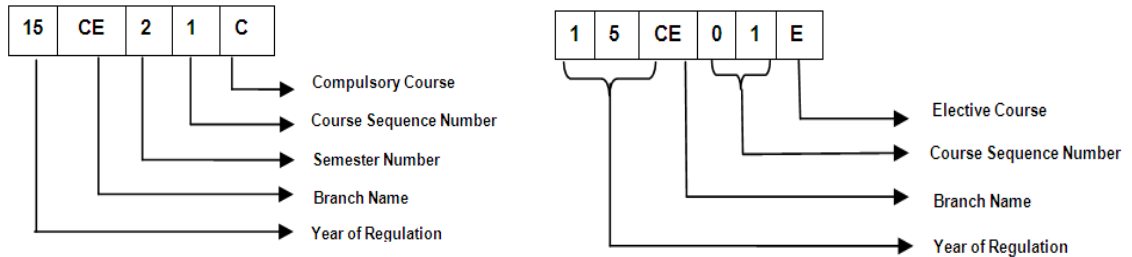
4. **Open Elective Courses (OEC)** include Inter-disciplinary and Trans-disciplinary courses. The students shall study Inter-disciplinary courses offered in other Engineering/Technology Programmes through regular mode and Trans-disciplinary courses through self study mode.
5. **Mandatory courses (MAC)** include the courses recommended by the regulatory bodies such as AICTE, UGC etc as given below:
 - a. Technical English / Professional English
 - b. Professional Ethics and Human Values
 - c. Environmental Science and Engineering
 - d. Communication Skills Laboratory
6. Every student shall undergo one Interdisciplinary and one Transdisciplinary course.

Performance in each course of study shall be evaluated based on Continuous Assessment throughout the semester and end semester examination at the end of the programme. Keeping in mind the content of the courses and delivery methods, different question paper patterns are suggested.

QP - Question Pattern

Question pattern	1 mark	2 marks	4 marks	10 marks	12 marks	16 marks	20 marks	Total
A	--	--	--	--	--	--	1 Qn Compulsory & 4 Qns (either or type)	100
B	--	10	--	--	--	1 Qn Compulsory & 4 Qns (either or type)	--	100
C	10	--	10 out of 12	1 Qn Compulsory & 4 Qns (either or type)	--	--	--	100
D	10	10	5 out of 6	1 Qn Compulsory & 4 Qns (either or type)	--	--	--	100
E	--	10	5 out of 6	--	1 Qn Compulsory & 4 Qns (either or type)	--	--	100
F	--	--	--	--	--	--	5 out of 8	100
G	--	5	--	2 Qns (either or type)	--	--	--	30

FORMAT FOR COURSE CODE



B.E. – CIVIL ENGINEERING
REGULATIONS – 2015
CURRICULUM AND SYLLABUS
SEMESTER – I

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15SH11C	Technical English*	3	0	0	3	B
2.	CFC	15SH12C	Mathematical Foundations for Engineers*	3	2	0	4	B
3.	CFC	15SH13C	Engineering Physics*	3	0	0	3	B
4.	CFC	15SH14C	Engineering Chemistry*	3	0	0	3	B
5.	CFC	15SH15C	Introduction to Engineering*	2	0	0	2	A
6.	CFC	15SH16C	Engineering Graphics*	2	0	2	3	A
PRACTICAL								
7.	CFC	15SH17C	Engineering Physics and Engineering Chemistry Laboratory*	0	0	2	1	
8.	CFC	15SH18C	Engineering Practice Laboratory*	0	0	2	1	
TOTAL				16	2	6	20	

SEMESTER – II

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15CE21C	Professional English*	3	0	0	3	B
2.	SFC	15CE22C	Calculus and Transforms	3	2	0	4	B
3.	SFC	15CE23C	Applied Physics	3	0	0	3	B
4.	SFC	15CE24C	Chemistry for Civil Engineering	3	0	0	3	B
5.	CFC	15CE25C	C Programming for Engineers*	3	0	0	3	B
6.	SFC	15CE26C	Engineering Mechanics	3	2	0	4	B
PRACTICAL								
7.	SFC	15CE27C	Physics and Applied Chemistry Laboratory	0	0	2	1	
8.	CFC	15CE28C	C Programming Laboratory*	0	0	2	1	
9.	SFC	15CE29C	Computer Aided Building drawing Laboratory	0	0	2	1	
TOTAL				18	4	6	23	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, XEC - X Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *Common to all B.E. / B.Tech., Programmes

SEMESTER – III

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15CE31C	Fourier Series, Probability and Statistics	3	2	0	4	B
2.	SFC	15CE32C	Solid Mechanics	3	2	0	4	B
3.	PCC	15CE33C	Fluid Mechanics	2	2	0	3	B
4.	PCC	15CE34C	Engineering Survey I	2	2	0	3	B
5.	PCC	15CE35C	Engineering Geology	3	0	0	3	B
6.	MAC	15CE36C	Environmental science and Engineering	3	0	0	3	B
PRACTICAL								
7.	PCC	15CE37C	Strength of Materials Laboratory	0	0	2	1	
8.	PCC	15CE38C	Engineering Survey Practical I	0	0	2	1	
TOTAL				16	8	4	22	

SEMESTER – IV

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15CE41C	Strength of Materials	3	2	0	4	B
2.	PCC	15CE42C	Applied Hydraulics and Hydraulic Machines	2	2	0	3	B
3.	MAC	15CE43C	Professional Ethics and Human Values*	3	0	0	3	A
4.	PCC	15CE44C	Highway Engineering	2	2	0	3	B
5.	PCC	15CE45C	Engineering Survey II	2	2	0	3	B
6.	PCC	15CE46C	Construction Materials, Equipments and Practices	3	0	0	3	B
PRACTICAL								
7.	PCC	15CE47C	Hydraulic Engineering Laboratory	0	0	2	1	
8.	PCC	15CE48C	Engineering Survey II Laboratory	0	0	2	1	
9.	MAC	15CE49C	Communication Skills Laboratory	0	0	2	1	
TOTAL				15	8	6	22	

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SEMESTER – V

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15CE51C	Structural Analysis I	3	2	0	4	B
2.	PCC	15CE52C	Design of Reinforced Concrete Elements	3	2	0	4	B
3.	PCC	15CE53C	Water Supply Treatment and Management	3	2	0	4	B
4.	PCC	15CE54C	Soil mechanics	3	2	0	4	B
5.	MAC	15CE55C	Project Management and Finance*	3	0	0	3	B
6.	XEC		Elective-I	3	0	0	3	
PRACTICAL								
7.	PCC	15CE56C	Concrete and Highway Laboratory	0	0	2	1	
8.	PCC	15CE57C	Soil Mechanics Laboratory	0	0	2	1	
TOTAL				18	8	4	24	

SEMESTER – VI

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15CE61C	Design of Steel Structures	3	2	0	4	B
2.	PCC	15CE62C	Structural analysis II	3	2	0	4	B
3.	PCC	15CE63C	Foundation Engineering	3	2	0	4	B
4.	PCC	15CE64C	Waste Water Treatment and Management	3	2	0	4	B
5.	PCC	15CE65C	Estimation and Quantity Surveying	3	0	0	3	B
6.	XEC		Elective -II	3	0	0	3	
PRACTICAL								
7.	PCC	15CE66C	Environmental Engineering Laboratory	0	0	2	1	
8.	PCC	15CE67C	Software Applications Laboratory	0	0	2	1	
9.	PCC	15CE68C	Product Development Laboratory	0	0	4	2	
TOTAL				18	8	8	26	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course, PCC – Programme Core Course, XEC - X Stands for P or O (PEC – Programme Elective Course, OEC – Open Elective Course) *Common to all B.E. / B.Tech., Programmes

SEMESTER – VII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15CE71C	Construction Project Management	3	0	0	3	B
2.	XEC		Elective-III	3	0	0	3	
3.	XEC		Elective-IV	3	0	0	3	
4.	XEC		Elective-V	3	0	0	3	
5.	XEC		Elective-VI	3	0	0	3	
6.	XEC		Elective-VII	3	0	0	3	
PRACTICAL								
7.	PCC	15CE72C	Mini Project	0	0	8	4	
8.	PCC	15CE73C	Research Paper and Patent Review- Seminar	0	0	2	1	
9.	PCC	15CE74C	Comprehension	0	0	2	1	
TOTAL				18	0	12	24	

SEMESTER – VIII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	XEC		Elective-VIII	3	0	0	3	
PRACTICAL								
2.	PCC	15CE81C	Project Work	0	0	20	10	
3.	PCC	15CE82C	Internship /In plant Training	0	0	0	2	
TOTAL				3	0	20	15	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, XEC - X Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *Common to all B.E. / B.Tech., Programmes

PROGRAMME ELECTIVE COURSES

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Structural Engineering Domain								
1.	PEC	15CE01E	Bridge Structures	3	0	0	3	B
2.	PEC	15CE02E	Storage Structures	3	0	0	3	B
3.	PEC	15CE03E	Theory of plates	3	0	0	3	A
4.	PEC	15CE04E	Tall Buildings	3	0	0	3	B
5.	PEC	15CE05E	Prefabricated Structures	3	0	0	3	B
6.	PEC	15CE06E	Computer Aided Design of Structures	3	0	0	3	B
7.	PEC	15CE07E	Industrial Structures	3	0	0	3	B
8.	PEC	15CE08E	Smart Structures and Smart Materials	3	0	0	3	B
9.	PEC	15CE09E	Repair and Rehabilitation of Structures	3	0	0	3	B
10.	PEC	15CE10E	Finite Element Techniques	3	0	0	3	B
11.	PEC	15CE11E	Design of Reinforced Concrete and Brick Masonry Structures	3	0	0	3	B
12.	PEC	15CE12E	Prestressed Concrete	3	0	0	3	B
13.	PEC	15CE13E	Basics of Dynamics and Aseismic Design	3	0	0	3	B
14.	PEC	15CE14E	Concrete Technology	3	0	0	3	B
15.	PEC	15CE15E	Design of steel concrete composite structures	3	0	0	3	A
16.	PEC	15CE16E	Advanced Steel Structures	3	0	0	3	A
17.	PEC	15CE17E	Design of Shell structures	3	0	0	3	A
18.	PEC	15CE18E	Experimental Stress Analysis	3	0	0	3	B
19.	PEC	15CE19E	Non Destructive Testing	3	0	0	3	B
Geotechnical Engineering Domain								
20.	PEC	15CE26E	Rock Engineering	3	0	0	3	B
21.	PEC	15CE27E	Ground Improvement Techniques	3	0	0	3	B
22.	PEC	15CE28E	Introduction to Soil Dynamics and Machine Foundations	3	0	0	3	B
23.	PEC	15CE29E	Earthquake Geotechnical Engineering	3	0	0	3	B
Environmental Engineering Domain								
24.	PEC	15CE46E	Environmental Impact Assessment	3	0	0	3	B
25.	PEC	15CE47E	Industrial Waste Management	3	0	0	3	B
26.	PEC	15CE48E	Air Pollution Management	3	0	0	3	B
27.	PEC	15CE49E	Municipal Solid Waste Management	3	0	0	3	B

28	PEC	15CE50E	Ecological Engineering	3	0	0	3	B
29	PEC	15CE51E	Environmental Instrumentation	3	0	0	3	B
Irrigation and Water Resources Engineering Domain								
30	PEC	15CE61E	Hydrology	3	0	0	3	B
31	PEC	15CE62E	Ground Water Engineering	3	0	0	3	B
32	PEC	15CE63E	Coastal Zone Management	3	0	0	3	B
33	PEC	15CE64E	Water Resources Engineering	3	0	0	3	B
Civil Engineering Management Domain								
34	PEC	15CE71E	Housing Planning and Management	3	0	0	3	B
35	PEC	15CE72E	Architecture and Town Planning	3	0	0	3	B
36	PEC	15CE73E	Total Quality Management	3	0	0	3	B
37	PEC	15CE74E	Engineering Economics and Cost Analysis	3	0	0	3	B
38	PEC	15CE75E	Intellectual Property Rights	3	0	0	3	B
39	PEC	15CE76E	Management of Irrigation Systems	3	0	0	3	B

Open Elective Course (OEC)
Group – I (Inter-disciplinary courses)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	15ID01E	Product Design and Development	3	0	0	3	A
2.	OEC	15ID02E	Disaster Management	3	0	0	3	A
3.	OEC	15ID03E	Energy Engineering	3	0	0	3	A
4.	OEC	--	Other Programme Courses	3	0	0	3	As specified for the Chosen Course

Group-II (Trans-disciplinary courses) - Self Study Course

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	15TD01E	Indian Business Laws	0	0	0	3	F
2.	OEC	15TD02E	Leadership and Personality Development	0	0	0	3	F
3.	OEC	15TD03E	International Business Management	0	0	0	3	F
4.	OEC	15TD04E	Basics of Marketing	0	0	0	3	F
5.	OEC	15TD05E	Retailing and Distribution management	0	0	0	3	F
6.	OEC	15TD06E	International Economics	0	0	0	3	F
7.	OEC	15TD07E	Indian Economy	0	0	0	3	F
8.	OEC	15TD08E	Rural Economics	0	0	0	3	F
9.	OEC	15TD09E	International Trade	0	0	0	3	F
10.	OEC	15TD10E	Global Challenges and issues	0	0	0	3	F
11.	OEC	15TD11E	Indian Culture and Heritage	0	0	0	3	F
12.	OEC	15TD12E	Indian History	0	0	0	3	F
13.	OEC	15TD13E	Sustainable Development and Practices	0	0	0	3	F
14.	OEC	15TD14E	Women in Indian Society	0	0	0	3	F
15.	OEC	15TD15E	Indian Constitution	0	0	0	3	F
16.	OEC	15TD16E	Bio Mechanics in Sports	0	0	0	3	F

L: 45 TOTAL: 45 PERIODS

Suggested Activity: Each student should read the suggested fiction for oral assignment

TEXT BOOKS

1. Rizvi. M. Ashraf, "Effective Technical Communication", 1st Edition, The Mc Graw Hill Education Private Limited, New Delhi, 2005.
2. Dutt P. K., Rajeevan G. and Prakash C.L.N., "A Course in Communication Skills", 1st Edition, Cambridge University Press, India, 2007.

REFERENCES

1. John Sinclair, "Collins Cobuild English Grammar", 3rd Edition, Collins Publishers, London, 2011.
2. Jan Svartvik, Sidney Greenbaum, Geoffery Leech, Randolph Quirk "A Comprehensive Grammar of the English Language", 2nd Edition, Longman Inc., Newyork, 2014.
3. Micheael Vince, Peter Sunderland, "Advanced Language Practice with Key", 3rd Edition, Macmillan Publishers Limited, Italy, 2003.

Listening files: Audio files from net sources,
Softwares: ODLL, Globarena.

15SH12C MATHEMATICAL FOUNDATIONS FOR ENGINEERS

(Common to all B.E. / B.Tech. Degree Programmes)

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: make use of orthogonal transformation. (K3)
- CO 2: use the basic concepts of three dimensional geometry in engineering. (K2)
- CO 3: obtain maxima and minima of real valued functions. (K3)
- CO 4: solve ordinary differential equations. (K3)
- CO 5: solve partial differential equations. (K3)

UNIT I MATRICES

15

Characteristic equation – Eigen values and Eigen vectors of a real matrix
– Independency and dependency of Eigen vectors – Properties of Eigen values and Eigen vectors (excluding proofs) - Diagonalisation of a matrix

by orthogonal transformation- Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature.

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 15

Direction cosines and Direction ratios- Planes and Lines - Equations of plane and line - Intersection of two planes - Shortest distance between two lines - Equation of a sphere - Plane section of a sphere - Tangent Plane - Orthogonal spheres.

UNIT III FUNCTIONS OF SEVERAL VARIABLE 15

Euler's theorem on homogeneous functions of two variables - Taylor's Series - Jacobians - Maxima and Minima - Constrained Maxima and Minima by the method of Lagrange multipliers.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 15

Solutions of higher order linear differential equations with constant coefficients - Cauchy's and Legendre's linear equations - Solutions of simultaneous first order linear equations with constant coefficients - Method of variation of parameters.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 15

Formation of partial differential equations - Lagrange's linear equations - Solutions of standard types of first order partial differential equations - Solutions of homogeneous linear partial differential equations of second and higher order with constant coefficients.

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Publications Private Limited, 2011.
2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.
3. Sharma.G.S and Sarna.I.J.S, "Engineering Mathematics", 10th Edition, CBS Publishers and Distributors, New Delhi, 2005.
4. James C. Robinson, "An Introduction to Ordinary Differential Equations", Cambridge University Press, 2004.

UNIT IV FIBER OPTICS AND ITS APPLICATIONS 9
Numerical aperture and Acceptance angle - Types of optical fibers - Double crucible technique – Splicing - Loss in optical fiber - Fiber optical communication system - Applications - Fiber optic sensors - Endoscope.

UNIT V QUANTUM PHYSICS 9
Photo electric effect - Matter Waves - Davison and Germer experiment - Heisenberg's Uncertainty principle - Schrodinger's wave equation - particle in one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", 10th Edition, John Wiley & Sons Inc.USA, 2014.
2. Arthur Beiser, "Concepts of Modern Physics", 6th Edition, McGraw Hill Publications Private Limited, 2008.

REFERENCES

1. Richard P.Feynmann, Robert B Leighton and Mathew Sands, "Feynmann's Lectures on Physics", 4th Edition, Addison Wesley Publication USA, 2010.
2. Yoav Peleg, Reuven Pnini, Elvahu Zaarur, Eugene Hecht, "Schaum's Outline of Quantum Mechanics", 2nd Edition, McGraw Hill Companions Limited, USA, 2010.
3. William T.Silfvast, "Laser Fundamentals", 2nd Edition, Cambridge University Press, NewYork, 2008.

15SH14C ENGINEERING CHEMISTRY L T P C
(Common to all B.E. / B.Tech. Degree Programmes) **3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: identify suitable water treatment techniques for industrial and domestic purpose.(K3)
- CO 2: explain the type of corrosion and corrosion control methods. (K3)
- CO 3: select the polymer for specific application. (K2)
- CO 4: explain the preparation, properties and applications of nano materials. (K2)
- CO 5: outline the principle and instrumentation of various analytical techniques. (K2)

UNIT I WATER TREATMENT 9

Types of water - hardness - estimation of hardness of water – disadvantages of using hard water in boiler – oils and silica in water; water softening – internal conditioning – external conditioning – domestic water treatment – desalination.

UNIT II CORROSION AND ITS CONTROL 9

Chemical corrosion – electrochemical corrosion – mechanism – different types of electrochemical corrosion – factors influencing corrosion – corrosion control methods.

UNIT III ENGINEERING POLYMERS 9

Polymers – polymerization – free radical mechanism – plastics – thermo plastics and thermosetting plastics – processing and moulding of plastics – special polymers: fire retardant, conducting, photonic and electro luminescent polymer; composites – polymer matrix composites.

UNIT IV NANO MATERIALS 9

Nanoparticles – synthesis of CNT – precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation – toxic effect of nano materials- properties and applications.

UNIT V ANALYTICAL TECHNIQUES 9

Principle, instrumentation and applications of UV-Visible and IR spectroscopy; chromatography: instrumentation and working of gas chromatography and HPLC; conductivity measurements – pH measurements – applications.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain P.C. and Jain. M., “Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
2. Dara S.S. and Umare S.S., “A text book of Engineering Chemistry”, S.Chand and Company Limited, New Delhi, 2013.
3. Chawla.S, “A text book of Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2015.

REFERENCES

1. Ahmed Z., “Principles of corrosion engineering and corrosion control”, Butterworth Heinemann, 2006.
2. Ebewele R.O., “Polymer science and Technology”, CFC Press, Newyork, 2000.

15SH16C ENGINEERING GRAPHICS L T P C
(Common to all B.E./B.Tech. Degree Programmes) 2 0 2 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: use the drawing instruments effectively. (K2, S4, A3)
- CO 2: draw the projections of points, straight lines, planes. (K2, S3, A3)
- CO3: construct the projections of various solids in different positions. (K3, S3, A3)
- CO 4: draw the sectional views of various solids and construct the true shape of the section. (K3, S3, A3)
- CO 5: identify and draw the surface areas of simple solids. (K3, S3, A3)
- CO 6: draw perspective views of simple solids and draw the orthographic views of simple objects. (K3, S3, A3)

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Drawing Instruments- IS specifications on lines- drawing sheets- Printing letters and dimensioning- scales - First angle projection. (Not for examination).

Projections of points and straight lines located in the first quadrant- Determination of true lengths and true inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes

UNIT II PROJECTION OF SOLIDS 12

Projections of simple solids - axis inclined to one reference plane - change of position method.

UNIT III SECTION OF SOLIDS 12

Sectioning of simple solids - cutting planes inclined to one reference plane and perpendicular to the other.

UNIT IV DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS 12

Development of lateral surfaces of simple and truncated solids - Principles of isometric projection and view of simple solids - truncated prism and pyramids.

UNIT V PERSPECTIVE PROJECTIONS AND ORTHOGRAPHIC PROJECTIONS 12

2. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
3. Determination of Dispersive power of a prism using Spectrometer.
4. Determination of Young's modulus – Uniform bending method.
5. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
7. Calibration of voltmeter / ammeter using potentiometer.
8. Determination of Frequency of A.C. mains using Sonometer.
9. Determination of the angular divergence of a laser beam using He-Ne laser or diode laser.
10. Determination of temperature coefficient of resistance.

P:15 TOTAL: 15 PERIODS

PART B - ENGINEERING CHEMISTRY LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: estimate the amount of hardness of the water sample (K5, S3)
- CO 2: determine the rate of corrosion (K5, S3)
- CO 3: synthesize a polymer and to determine molecular weight of the polymer (K6, S3)
- CO 4: synthesize silver nano particles (K6,S3)
- CO 5: quantify different ions by different analytical techniques (K5,S3)

LIST OF EXPERIMENTS

1. Estimation of hardness of water sample by EDTA method
2. Rate of corrosion- weight loss method
3. Synthesis of urea-formaldehyde resin
4. Determination of molecular weight of a polymer – Oswald's viscometer
5. Synthesis and characterization of silver nano particles.
6. Estimation of iron (Fe^{2+}) in water sample by dichrometry
7. Estimation of hydrochloric acid by conductometric method
8. Estimation of mixture of acids by conductometric method
9. Determination of purity of simple organic compounds using HPLC- (Demo).

P: 15 TOTAL: 15 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. Harris D.C., "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H. Freeman, 2010.
2. Mendham J., "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman Scientific & Technical, 1989.

15SH18C ENGINEERING PRACTICE LABORATORY L T P C
(Common to all B.E./B.Tech. Degree Programmes) **0 0 2 1**

PART A - MECHANICAL LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: prepare basic carpentry jobs (at least three joints). (K3,S2, A2)
- CO 2: prepare the welded joint (minimum three) using arc and gas welding. (K3, S2, A2)
- CO 3: Machine metals using lathe, shaper and drilling machine (each one job). (K3, S2, A2)

UNIT I CARPENTRY PRACTICES 5
Study of carpentry tools – preparation of joints like half lap, Tee and dove tail in wood.

UNIT II WELDING 5
Study of welding tools – Preparation of welded joints with Mild steel specimen like lap, butt and tee joints using ARC and Gas welding. (any one exercise should be given using Gas welding among three)

UNIT III BASIC MACHINING PRACTICES 5
Simple turning and taper turning using lathe – use of shaper and drilling machine for basic operations (Minimum three exercises should be given for students)

P: 15 TOTAL: 15 PERIODS

TEXT BOOK

1. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.

REFERENCES

1. Ramesh Babu V, "Engineering Practices Laboratory Manual", Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan T, Saravanapandian M. and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, "Workshop Practice", Sree Sai Publication, 2002
5. Kannaiyah P and Narayana KL, "Manual on Workshop Practice", Scitech Publications, 1999.

PART – B ELECTRICAL AND ELECTRONICS LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

- CO 1: develop simple residential wiring circuits. (K6)
- CO 2: calculate the basic electrical quantities. (K4)
- CO 3: identify the value of resistance using appropriate methods. (K4, A4)
- CO 4: realize the fundamentals of Boolean algebra using digital logic gates. (A4)
- CO 5: practice soldering to design PCB for electronic circuits. (A5)

I. ELECTRICAL ENGINEERING PRACTICE 8

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

II. ELECTRONICS ENGINEERING PRACTICE 7

1. Study of Electronic components and equipments – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, XOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

5. Measurement of ripple factor of HWR and FWR.

P: 15 TOTAL: 15 PERIODS

REFERENCES

1. Jeyachandran K, Natarajan S and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T, Saravanapandian M and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
3. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A and Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
5. Kannaiah P and Narayana K.L, "Manual on Workshop Practice", Scitech Publications, 1999.

15CE21C

PROFESSIONAL ENGLISH

L T P C

(Common to all B.E. / B.Tech. Degree Programmes)

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: contribute the lingual power to frame sentences in different context. (A2)
- CO 2: write effectively in any Professional context. (A2)
- CO 3: acquire the skills related to Group discussion. (A2)
- CO 4: communicate and respond in different social and professional contexts. (A3)
- CO 5: recall the acquired skills in solving competitive exam. (K3)

UNIT I

9

Phrasal Verbs (Based on root words: call, come, get, look, put, run, and take) - Foreign Words and Phrases (from the given list) - Listening to audio files and finding the technical words and framing different sentences - Channel conversion- Descriptive writing on various charts.

UNIT II

9

Idioms and Phrases (with animal names from the given list) - Report writing (types-structure- stages in report writing- model report) - Job Application Letter with curriculum vitae.

UNIT III **9**

One word substitution (from the list given) Group Discussion (Why is GD a part of selection process? - Structure of GD – Strategies in GD – Team Work - Body Language - Video Samples-GD).

UNIT IV **9**

Choosing a suitable connotation (from the given list) - Note making – Preparing Circular and Minutes of meeting – Listening to TED Talks – Giving opinion on the given TED Talks and interviewing the TED talkers.

UNIT V **9**

Error Spotting (Tense, Relative Pronouns, Conjunctions, Sentence Structure, Adverb Placement) Sentence Completion - Reading comprehension.

L: 45 TOTAL: 45 PERIODS

Activity: Each student should read the suggested fiction for oral assignment.

TEXT BOOK

1. Tyagi Kavita and Padma Misra, “Advanced Technical Communication”, 1st Edition, PHI Learning Private Limited, New Delhi, 2011.

REFERENCES

1. Smith-Worthington, Darlene & Sue Jefferson. “Technical Writing for Success”, 1st Edition, Cengage Mason, USA, 2007.
2. Bovee, Courtland L., John V.Thill. “Business Communication Today”, 12th Edition, Pearson Education, New Delhi, 2013.
3. Anderson, Paul V. “Technical Communication: A Reader - Centered Approach”, 8th Edition, Cengage, New Delhi, 2013.

Listening files: Audio files from net sources and softwares: ODLL, Globberena.

15CE22C	CALCULUS AND TRANSFORMS	L T P C
		3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: evaluate area and volume of objects using double and triple integrals. (K3)

REFERENCES

1. Bali N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Publications Private Limited, 2011.
2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Private Limited, 2007.
4. Anthony Croft, Robert Davison, Martin Hargreaves James Flint, "Engineering Mathematics: A Foundation for Electronic, Electrical, Communications and System Engineers", 4th Edition, Pearson Education Private Limited, 2013.

15CE23C

APPLIED PHYSICS

L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: summarize the working principles and limitations of pumps, gauges and other vacuum system components.(K2)
- CO 2: infer the measurement of optical properties of surfaces and materials. (K2)
- CO 3: express the thermal properties of materials. (K2)
- CO 4: predict the mechanism by which the electric field interacts with Dielectric material and their applications. (K2)
- CO 5: describe the advanced materials' properties which are used in engineering applications and devices.(K2)

UNIT I VACUUM SCIENCE AND TECHNOLOGY 9

Types of Vacuum Pumps – Working Principle – Rotary Pumps and diffusion pumps - Turbo molecular pump - Operational Pressure Gauges - Range and measurement of Vacuum using penning and pirani gauges - Vacuum systems and applications.

UNIT II PHOTOMETRY 9

Solid Angle – Definition, Luminous Flux – Luminous intensity - laws of illumination, Photoelectric Illumination meter, Definition of Reflection, Coefficient of Surface – Determination of reflection coefficient of surface and transmission coefficient of surface.

UNIT III THERMAL PHYSICS 9

Modes of heat transfer - rectilinear flow of heat along a bar - radial flow of heat – Spherical shell method, Thermal conductivity of bad conductor –

Lee's disc method - Thermal insulation in the building - Practical application of heat conduction and convection - ventilation – radiators.

UNIT IV DIELECTRIC MATERIALS 9

Types of Polarization – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization; Internal field – Clausius-Mosotti relation (derivation); dielectric loss, dielectric breakdown, Uses of dielectric materials in capacitor and transformer.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Nano Phase materials - Shape memory alloys - Metallic glass - Fibre reinforce plastics - Advanced ceramics materials - MEMS.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Rao V.V, Ghosh T.B and Chopra K.L, "Vacuum Science and Technology", Allied Publishers Limited, New Delhi, 1998.
2. Michael Bass and Casimer DeCusatis "Handbook of Optics: Volume II - Design, Fabrication, and Testing; Sources and Detectors; Radiometry and Photometry", 3rd Edition, McGraw Hill Professional, 2010.
3. Daniel V Schroeder "An introduction to Thermal Physics", 1st Edition, Addison Wesley, USA, 1999
4. Charles Kittel, "Introduction to Solid State Physics", 7th Edition, John Wiley and Sons, Singapore, 2007.

REFERENCES

1. William D.Callister,Jr, "Materials Science and Engineering An introduction", 6th Edition, John Wiley and Sons, 2004.
2. Hugh D. Young Roger A. Freedman "University Physics with Modern Physics", 13th Edition, Pearson Publishers, 2011.

**15CE24C CHEMISTRY FOR CIVIL ENGINEERING L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: analyze the water quality parameters. (K4)
- CO 2: acquire knowledge of electrochemistry and its applications. (K3)
- CO 3: identify various protective coating methods and adhesives. (K3)
- CO 4: select proper engineering materials for desired engineering application. (K3)
- CO 5: select proper building materials for desired structural application. (K3)

UNIT I WATER ANALYSIS 9

Water quality parameters and standards for drinking and construction - water quality parameter analysis – spectrophotometric determination of iron in water – flame photometric determination of Na and K in water.

UNIT II ELECTROCHEMISTRY AND ITS APPLICATION 9

Electrode potential – Nernst equation – EMF and its measurement - reference electrode - measurement of pH using glass electrode – potentiometric redox titration – electroplating, electroless plating and anodizing.

UNIT III PROTECTIVE COATINGS AND ADHESIVES 9

Organic coatings – paint and special paints – varnishes, lacquers and enamels – adhesive : adhesive action – physical and chemical factors influencing adhesive action.

UNIT IV ENGINEERING MATERIALS 9

Ceramics – glasses – types of glasses – refractories – classification and properties – abrasives – classification and uses.

UNIT V CHEMISTRY OF BUILDING MATERIALS 9

Manufacture, properties, setting and hardening of lime, cement and plaster of Paris; special cement; polymers for building industries – flooring, roofing, special coatings.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
2. Dara S.S. and Umare S.S., “A text book of Engineering Chemistry”, S. Chand and Company Limited, New Delhi, 2013.
3. Chawla S, “A text book of Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2015.

REFERENCES

1. Hammer Mark J, “Water and Waste water Technology”, Prentice Hall, New Arrivals, 2011.
2. Glasstone S, “An introduction to Electrochemistry”, 10th Edition, Affiliated to East West Press Private Limited, 2007.
3. Tracton A.A, “Coating materials and surface coatings”, CRC Press, Taylor and Francis group, Newyork, 2007.

4. Harvey K.W, "Fundamentals of building materials", Universal Publishers, Florida, USA, 2009.
5. Duggal S K, "Building materials", 3rd Edition, New Age International Private Limited, 2012.
6. Rajput R.K, "Engineering Materials and Metallurgy", 1st Edition, S.Chand and Company Private Limited, New Delhi, 2008.

15CE25C C PROGRAMMING FOR ENGINEERS L T P C
(Common to all B.E. / B.Tech. Degree Programmes) **3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: recognize the system fundamentals and the role of hardware components of the Computer. (K3)
- CO 2: apply the basic concepts and solve simple problems by analyzing the logics of conditional statements and looping constructs. (K3)
- CO 3: handle similar types of data using array and utilize their functionality. (K3)
- CO 4: appreciate the call by value and call by reference features in functions. (K5)
- CO 5: design programs involving their own derived data types, pointers, memory allocation concepts. (K4)
- CO 6: handle the file contents with access permissions. (K3)

UNIT I COMPUTER FUNDAMENTALS 10

Introduction – Characteristics of Computers – Evolution of Computers – Computer Generations – Classification of Computers – Basic Computer organization – Number Systems – Problem Analysis – Algorithms – Flow charts – Computer Software – Types of Software.

UNIT II BASIC C PROGRAMMING 9

Overview of C Program – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operations – Decision Making and Branching – Decision making and Looping.

UNIT III ARRAYS AND FUNCTIONS 9

Arrays: One dimensional arrays – Two dimensional arrays – Multi dimensional arrays. Character arrays and Strings: Declaring and initializing String Variables – Comparison of two strings – String handling

functions. User defined Functions: Definition – Declaration – Function calls – Category of Functions – Recursion - Storage Classes.

UNIT IV STRUCTURES AND POINTERS 9

Structures and Unions: Definition – Declaration – Accessing structures – Initialization of structures – Arrays of structures – Arrays within Structure – Structures within Structures -Structures and functions - Unions. Pointers: Initialization – Pointers and arrays- Array of pointers – Pointers as function arguments – Pointers to functions – Pointers and Structure.

UNIT V FILES AND DYNAMIC MEMORY ALLOCATION 8

File management in C – Defining and opening a file – closing a file - Input and Output operations on file – Error handling during IO operations – Random access to files – Command line Arguments. Dynamic memory allocation: Allocating a block of memory - Allocating a multiple block of memory – Releasing the used space – Altering the size of a block.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Ashok.N.Kamthane, “Computer Programming”, Pearson Education, India, 2008.
2. E. Balagurusamy, “Programming in ANSI C”, 6th Edition Multicolor, 2013.

REFERENCES

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, 1st Edition, Oxford University Press, 2009
2. Stephen G.Kochan, “Programming in C”, 3rd Edition, Pearson Education, India, 2005.
3. Brian W.Kernighan and Dennis M.Ritchie, “The C Programming Language”, Pearson Education Inc., 2005.

15CE26C

ENGINEERING MECHANICS

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: use the basic concept of force systems and solve problems.
- CO 2: implement the knowledge acquired in supports, reactions, equilibrium of rigid bodies for solving problems.
- CO 3: predict centre of gravity, moment and product moment of inertia of simple configurations.

CO 4: solve practical problems on Projectiles, Newton's laws, work-energy, impulse momentum and impact on elastic bodies.

CO 5: apply the principles of friction and rigid body dynamics to analyze and solve problems.

UNIT I BASICS AND STATICS OF PARTICLES 15

Introduction – Units and Dimensions – Laws of Mechanics – Lamé's theorem, Parallelogram and triangular Law of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force – Vectorial representation of forces.

UNIT II EQUILIBRIUM OF RIGID BODIES 15

Free body diagram - Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis, Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 15

Determination of Areas and Volumes– First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard formula - second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem. Principal moment of inertia of plane areas – principal axes of inertia – Mass moment of inertia – mass moment of inertia for prismatic, cylindrical and spherical solids from first principal – relation to area moments of bodies.

UNIT IV DYNAMICS OF PARTICLES 15

Displacements, Velocity and acceleration, their relationship – Projectile motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum.

Definition – time of compression, restitution, collision – laws of conservation of momentum – coefficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – loss of kinetic energy.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 15

Frictional force – Laws of Coulomb friction – Simple contact friction – Rolling resistance – Belt friction – Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Beer, F.P. and Johnson Jr. E.R., "Vector Mechanics for Engineers", Vol.1 Statics and Vol.2 Dynamics, 9th Edition, McGraw Hill International, 2010.
2. Vela Murali, "Engineering Mechanics" Oxford University, 2010.

REFERENCES

1. Rajasekaran S, Sankarasubramanian G., "Fundamentals of Engineering Mechanics", 3rd Edition, Vikas Publishing House Private Limited, 2010.
2. Hibbeler R.C., "Engineering Mechanics", Vol.1 Statics, Vol.2 Dynamics, 12th Edition, Pearson Education Asia Private Limited, 2010.
3. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education Asia Private Limited, 2009.

15CE27C PHYSICS AND APPLIED CHEMISTRY LABORATORY

L T P C
0 0 2 1

PART A – PHYSICS LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: demonstrate the optical properties of waves. (K2, S3)
- CO 2: analyze the characteristics of semiconducting materials and devices. (K3,S3)
- CO 3: quantify the acceleration due to gravity (g). (K2,S3)
- CO 4: analyze the thermal properties of materials. (K3,S3)

LIST OF EXPERIMENTS

1. a. Determination of wave length of Laser source.
b. Particle size determination using Diode Laser.
c. Determination of Numerical aperture and acceptance angle of an optical fiber.

2. Determination of Band Gap of a semiconductor material.
3. Determination of Radius of curvature of a Plano convex lens using Newton's rings Method.
4. Determination of wavelength of mercury spectrum using spectrometer & grating.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of g using compound pendulum.
7. Determination of Hall Coefficient.
8. Specific heat capacity of liquid – Newton's law of cooling.
9. Characteristics of LED.
10. Study of V-I characteristics of a solar cell.

P:15 TOTAL: 15 PERIODS

PART - B APPLIED CHEMISTRY LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: determine various water quality parameters (K3, S3)
- CO 2: quantify the amount of metal ions in water sample by different analytical techniques (K3, S3)
- CO 3: determine the amount of acid by pH metric method (K3, S3)
- CO 4: estimate the free acid value of driers in paints (K3,S3)
- CO 5: synthesize a polymer used as a building material. (K3,S3)

LIST OF EXPERIMENTS

1. Estimation of iron (Fe^{2+}) by spectrophotometric method.
2. Estimation of sodium by flame photometry.
3. Estimation of amount of alkalinity in water.
4. Estimation of iron (Fe^{2+}) by potentiometric method.
5. Estimation of amount of acid - pH metric method.
6. Estimation of free acid value of driers in paints.
7. Synthesis of phenol – formaldehyde resin.
8. Estimation of Chloride ion by argentometric method.

P: 15 TOTAL: 15 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. Harris D.C, "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H.Freeman, 2010.
2. Mendham J, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I, "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman scientific & Technical, 1989.

15CE28C

C PROGRAMMING LABORATORY

(Common to all B.E. / B.Tech. Degree Programmes)

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: solve the given problem using the syntactical structures of C language. (K3)
- CO 2: develop, execute and document computerized solution for various logic based problems using the flow control features of C language. (K3)
- CO 3: enhance the programming skills in C by discriminating constants, variables and arrays and the functionality. (K3)
- CO 4: learn about the connection between function return values and variables. (K5)
- CO 5: develop programs using string manipulation and file manipulation functions. (K3)

Simple programs

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Solving the roots of a quadratic equation
3. Designing a simple arithmetic calculator. (Use switch statement)
4. Given distance traveled by a vehicle as $d = ut + \frac{1}{2}at^2$, where 'u' and 'a' are the initial velocity and acceleration. Calculate the distance traveled for different time intervals

Programs using different control structures

5. Performing the following operations:
 - a. Generate Pascal's triangle.
 - b. Construct a Pyramid of numbers.
6. Generation of the first 'n' terms of the Fibonacci sequence and prime sequence.
7. Computing Sine series and Cosine series.
8. Finding the 2's complement of a binary number.

Programs using arrays

9. Performing the following operations:
 - a. Matrix addition.
 - b. Transpose of a matrix.
 - c. Matrix multiplication by checking compatibility.

Programs using string manipulation

10. Performing the following operations to a string:
 - a. To insert a sub-string into main string at a given position.
 - b. To delete 'n' characters from a given position in a string.
 - c. To replace a character of string either from beginning or ending or at a specified location.

Programs using functions

11. Performing the following operations: (Use recursive functions)
 - a. To find the factorial of a given integer.
 - b. To find the GCD (Greatest Common Divisor) of two given integers.
 - c. To solve Towers of Hanoi problem.

Programs using files

12. Performing the Student Information Processing using Structures and File handling concepts.

P: 30 TOTAL: 30 PERIODS

15CE31C FOURIER SERIES, PROBABILITY AND STATISTICS

L T P C
3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Perform Fourier series analysis of the functions. (K2)
- CO2: Compute the Fourier transforms of various functions. (K2)
- CO3: Grasp basic probability concepts.(K2)
- CO4: Understand various probability distributions(K3)
- CO5: Apply the concepts of test of hypothesis. (K3)

UNIT I FOURIER SERIES 15

Dirichlet's conditions – General Fourier series– Half range series– Harmonic analysis–Solution of One dimensional wave equation by Fourier series.

UNIT II FOURIER TRANSFORMS 15

Fourier Integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PROBABILITY 15

Sample spaces and events – Counting – Probability – Axioms of probability – Some elementary theorems – Conditional probability – Baye's theorem – Mathematical expectation and Decision making.

UNIT IV PROBABILITY DISTRIBUTIONS 15

Random variables – Discrete and Continuous distribution – Binomial, Poisson, Geometric and Hyper Geometric distributions, Uniform, Exponential, Gamma, Beta, Weibull, Log-normal and Multinomial distribution.

UNIT V TEST OF HYPOTHESIS 15

Population and samples – Sampling distribution of mean(σ known) - Sampling distribution of mean(σ unknown) - Sampling distribution of variance – Hypothesis concerning one mean – Inferences concerning two means – Randomization and pairing – Estimation of variances – Hypotheses concerning one variance - Hypotheses concerning two variances – Estimation of proportions – Bayesian estimation – Hypothesis concerning one proportion - Hypothesis concerning several proportions – Analysis of $r \times c$ tables – Goodness of fit.

L:45; T:30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Publications Private Ltd., 2011.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Private Limited, 2007.
4. A.O. Allen, "Probability, Statistics and Queueing Theory with Computer Applications", 2nd edition, Elsevier, 2005.

15CE32C

SOLID MECHANICS

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Identify the basic properties of solids. (K3)
- CO2: Analyze plane truss. (K3)
- CO3: Dramatize bending moment and shear force diagram for different types of beams (K3)
- CO4: Identify the deformation in beams and shear stresses (K3)
- CO5: Determine torsion in shafts and springs (K3)

UNIT I **STRESS STRAIN AND DEFORMATION OF SOLIDS, STATES OF STRESS**

15

Rigid bodies and deformable solids – Stability, strength, stiffness – Tension, compression and shear stresses – Strain, elasticity, Hooke's law, limit of proportionately, modulus of elasticity, stress -strain curve, lateral strain – Temperature stresses – Deformation of simple and compound bars – Shear modulus, bulk modulus, relationship between elastic constants – Biaxial state of stress – Stress at a point – Stress on inclined plane – Principal stresses and principal planes – Mohr's circle of stresses.

UNIT II **ANALYSIS OF PLANE TRUSS**

15

Stability and equilibrium of plane frames – Types of trusses – Analysis of forces in truss member's method of joints, method of sections, method of tension coefficients – Graphical Method.

UNIT III TRANSVERSE LOADING ON BEAMS 15

Beams – Types of supports – Simple and fixed, types of load – Concentrated, uniformly distributed, varying distributed load, combination of above loading – Relationship between bending moment and shear force – Bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Theory of simple bending – Analysis of stresses – Load carrying capacity of beams – Proportioning of sections.

UNIT IV DEFLECTION OF BEAMS AND SHEAR STRESSES 15

Deflection of beams – Double integration method – Macaulay's method – Slope and deflection using moment area method, Conjugate Beam method – Variation of shear stress – Shear stress distribution in rectangular, I sections, solid circular sections, hollow circular sections, angle and channel sections – Shear flow – Shear centre.

UNIT V TORSION AND SPRINGS 15

Stresses and deformation in circular (solid and hollow shafts) – Stepped shafts – Shafts fixed at both ends – Leaf springs – Stresses in helical springs – Deflection of springs.

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Rajput R.K, "Strength of Materials", S.Chand and Company Limited, New Delhi, 2007.
2. Ramamurtham S, "Strength of Materials", DhanpatRai Publishing Company Private Limited, 2011

REFERENCE

1. Subramanian R, "Strength of materials", Oxford university press, New Delhi, 2005.

15CE33C

FLUID MECHANICS

L T P C

2 2 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Illustrate the basic fluid properties. (K2)
- CO2: Identify the pressure in fluid and calculate hydrostatic forces and moments on submerged and partially submerged surfaces and concepts of continuity equation.(K3)
- CO3: Make use of Bernoulli's equation and describe the condition of flow in a circular pipe. (K3)

CO4: Explain the concepts of boundary layer, friction and Minor losses and pipes connected in series and parallel. (K2)

CO5: Explain dimensional analysis to determine dimensionless parameters and use the parameter for scaling and other model/prototype problems. (K2)

UNIT I DEFINITIONS AND FLUID PROPERTIES 12

Definitions – Fluid and fluid mechanics – Dimensions and units – Fluid properties – Continuum Concept of system and control volume.

UNIT II FLUID STATICS AND KINEMATICS 12

Pascal's Law and Hydrostatic equation – Forces on plane and curved surfaces – Buoyancy – Meta centre – Pressure measurement – Fluid mass under relative equilibrium-Fluid Kinematics - Stream, streak and path lines – Classification of flows – Continuity equation (one, two and three dimensional forms) – Stream and potential functions – flow nets – Velocity measurement (Pitot tube, current meter, Hot wire and hot film anemometer, float technique, Laser Doppler velocimetry).

UNIT III FLUID DYNAMICS 12

Euler and Bernoulli's equations – Application of Bernoulli's equation – Discharge measurement – Laminar flows through pipes and between plates – Hagen Poiseuille equation – Turbulent flow – Darcy – Weisbach formula – Moody diagram – Momentum Principle.

UNIT IV BOUNDARY LAYER AND FLOW THROUGH PIPES 12

Definition of boundary layer – Thickness and classification – Displacement and momentum thickness– Development of laminar and turbulent flows in circular pipes – Major and minor losses of flow in pipes – Pipes in series and in parallel – Pipe network.

UNIT V SIMILITUDE AND MODEL STUDY 12

Dimensional Analysis – Rayleigh's method, Buckingham's Pi-theorem – Similitude and models – Scale effect and distorted models.

L: 30; T: 30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Modi, P.N. & Seth, S.M "Hydraulics and fluid Mechanics", Standard book house, New Delhi, 2015.
2. Bansal R.K, "Fluid mechanics and Hydraulic machines", Laxmi Publishing Private Limited, New Delhi, 2011

REFERENCES

1. Streeter, Victor, L. and Wylie, Benjamin E., "Fluid Mechanics", McGraw-Hill Limited, 1998.
2. Kumar, K.L., "Engineering Fluid Mechanics", S.Chand Ltd., New Delhi, 2008.
3. Rajput, R.K., "A text book of Fluid Mechanics", S.Chand and Company, New Delhi, 2007.

15CE34C

ENGINEERING SURVEY- I

L T P C
2 2 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explain the basic principle of chain surveying. (K2)

CO2: Interpret the working principle of compass and plane table surveying. (K2)

CO3: Demonstrate the application of leveling in the field surveying.(K2)

CO4: Demonstrate the application of theodolite in the field surveying. (K2)

CO5: Outline engineering surveys and usage of modern surveying instruments. (K2)

UNIT I INTRODUCTION AND CHAIN SURVEYING 12

Definition - Principles - Classification - Field and office work - Scales - Conventional signs - Survey instruments, their care and adjustment - Ranging and chaining - Reciprocal ranging - Setting perpendiculars - well conditioned triangles - Traversing - Plotting - Enlarging and reducing figures.

UNIT II COMPASS SURVEYING AND PLANE TABLE SURVEYING 12

Prismatic compass - Surveyor's compass - Bearing - Systems and conversions - Local attraction - Magnetic declination - Dip - Traversing - Plotting - Adjustment of errors - Plane table instruments and accessories - Merits and demerits - Methods - Radiation - Intersection - Resection - Traversing.

UNIT III LEVELLING AND APPLICATIONS 14

Level line - Horizontal line - Levels and Staves - Spirit level - Sensitiveness - Bench marks - Temporary and permanent adjustments - Fly and check levelling - Booking - Reduction - Curvature and refraction - Reciprocal levelling - Longitudinal and cross sections - Plotting -

Calculation of areas and volumes - Contouring - Methods - Characteristics and uses of contours - Plotting - Earth work volume - Capacity of reservoirs.

UNIT IV THEODOLITE SURVEYING 10

Theodolite - Vernier and microptic - Description and uses - Temporary and permanent adjustments of vernier transit - Horizontal angles - Vertical angles - Heights and distances - Traversing - Closing error and distribution - Gale's tables - Omitted measurements.

UNIT V ENGINEERING SURVEYS AND MODERN INSTRUMENTS 12

Reconnaissance, preliminary and location surveys for engineering projects - Lay out - Setting out works - Route Surveys for highways, railways and waterways - Mine Surveying - instruments - Tunnels - Correlation of underground and surface surveys - Shafts – Adits - Electromagnetic distance measurement - Carrier waves - Principles – Instruments –Total Station –GPS.

L: 30; T:30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Bannister A. and Raymond S., "Surveying", ELBS, 6th Edition, 2006.
2. Punmia B.C. "Surveying", Vols. I, II and III, Laxmi Publications, 2005

REFERENCES

1. Clark D., "Plane and Geodetic Surveying", Vols. I and II, C.B.S. Publishers and Distributors, Delhi, 6th Edition, 2004.
2. James M.Anderson and Edward M.Mikhail, "Introduction to Surveying", McGraw-Hill Book Company, 7th Edition 2012.
3. Kanetkar T.P., "Surveying and Levelling", Vols. I and II, United Book Corporation, Pune, 2006.

15CE35C

ENGINEERING GEOLOGY

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Illustrate the concepts of geological formations, weathering and plate tectonics which are the reasons of earthquakes. (K2)
- CO2: Interpret the physical, mechanical and engineering properties of minerals along with formation of coal and petroleum. (K2)
- CO3: Interpret the physical, mechanical and engineering properties of rocks. (K2)

CO4: Outline the importance of geological structures and geophysical investigations. (K2)

CO5: Explain the importance of geological investigations in civil engineering. (K2)

UNIT I GENERAL GEOLOGY 9

Geology in Civil Engineering – Branches of geology – Earth Structures and composition –Elementary knowledge on continental drift and plate technologies. Earth processes – Weathering – Work of rivers, wind and sea and their engineering importance – Earthquake belts in India.

UNIT II MINERALOGY 9

Elementary knowledge on symmetry elements of important crystallographic systems – physical properties of minerals – study of the following rock forming minerals – Quartz family. Feldspar family, Augite, Hornblende, Biotite, Muscovite, Calcite, Garnet – properties, behavior and engineering significance of clay minerals – Fundamentals of process of formation of ore minerals – Coal and petroleum – Their origin and occurrence in India.

UNIT III PETROLOGY 9

Classification of rocks – distinction between igneous, sedimentary and metamorphic rocks. Description occurrence, engineering properties and distribution of following rocks. Igneous rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt Sedimentary rocks sandstone, Limestone, shale, Conglomerate and Breccia. Metamorphic rocks Quartzite, Marble, Slate, Gniess and Schist.

UNIT IV STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD 9

Attitude of beds – Outcrops – Introduction to Geological maps – study of structures – Folds, faults and joints – Their bearing on engineering construction. Seismic and Electrical methods for Civil Engineering investigations.

UNIT V GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING 9

Remote sensing techniques – Study of air photos and satellite images – Interpretation for Civil Engineering projects – Geological conditions necessary for construction of Bridges, Dams, Reservoirs, Tunnels, Buildings, Road cuttings.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. ParbinSingh, "Engineering and General Geology", Katson Publication House, 2008.
2. Krynine and Judd, "Engineering Geology and Geotechniques", McGraw-Hill Book Company, 1st Edition 2005.

REFERENCES

1. Legeet, "Geology and Engineering", McGraw-Hill Book Company, 1998
2. Blyth, "Geology for Engineers", ELBS, 1995
3. Bangar K.M, Principles of Engineering Geology, Standard Publishers and distributors, 2009

15CE36C ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C 3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain the nature of various ecosystem their structure, composition, function, inter – dependency and values. (K2)
- CO2: Classify the different types of natural resources and identify the role of individual in conservation of resources. (K2)
- CO3: Identify sources of environmental pollution and assess its implication. (K3)
- CO4: Identify the different types of environmental hazards and their management. (K3)
- CO5: Analyse the social issues related to the environment and how human population affect the environment. (K4)

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – Need for public awareness – Kingdom of plants and animals - Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers– Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) aquatic (pond) ecosystems – Pond and forest- Introduction to biodiversity: definition - Values of biodiversity –India as a mega-diversity nation – Hot spots of biodiversity –Threats to biodiversity - Endangered and endemic species of India – Conservation of biodiversity-Field study of ecosystem, common plants, insects, birds.

UNIT II NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies-
Water resources: Use and overutilization of surface and ground water –
Food resources: World food problems, changes caused by agriculture and
overgrazing, effects of modern agriculture, fertilizer-pesticide Problems,
water logging, salinity, case studies – Zero carbon technologies –
Renewable energy sources- solar,wind,hydropower and hydrogen fuels,
biomass and carbon neutral – Role of an individual in conservation of
natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest
/ grassland / hill / mountain.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution –
Vehicular emission (b) Water pollution (c) Soil pollution (d) Noise pollution
(e) Nuclear hazards – Solid waste management: causes, effects and
control measures of municipal solid wastes – e-Waste: Definition-
dimension of the problem - source-Toxic substances in e-waste - Risks
related to toxic substances–Environmental problems-role of an individual
in prevention of pollution-Green chemistry-green solvent, renewable feed
stock ,waste minimization,3Rs principle.

UNIT IV ENVIRONMENTAL HAZARDS 9

Environmental hazards: Definition – Hazard- Types-Natural and man-
made hazards – Natural hazards: Causes, effect and management of
Earthquake, Flood, Landslide, Cyclones and Tsunami; Man-made
Hazards: Hazards due to dams and reservoirs, hazards due to nuclear
power plant, Industrial hazards. Case study: Chernobyl disaster, Bhopal
gas tragedy.

UNIT V SOCIAL ISSUES, HUMAN POPULATION AND THE ENVIRONMENT 9

Water conservation: rain water harvesting-climate change: global
warming, acid rain, ozone layer depletion-Population growth, variation
among nations – Population explosion – Family welfare programme –
Environment and human health – Human rights – Value education – HIV /
AIDS – role of information technology in environment and human health –
Case studies.

L:45 , TOTAL: 45 PERIODS

TEXT BOOKS

1. Ravikrishnan. A., “Environmental Science and Engineering, Sri
Krishna Hitech Publishing Company Private Limited, 2010.

13. LS and CS
14. Measurement of horizontal angles by reiteration and repetition methods using theodolite
15. Measurement of vertical angles using theodolite

SURVEY PRACTICAL I & SURVEY PRACTICAL II		
<u>LIST OF EQUIPMENTS</u>		
(For a batch of 30 students)		
Sl. No.	Description of Equipments	Quantity
1	Total Station	2 Nos
2	Theodolites	Atleast 1 for every 5 students
3	Dumpy level	Atleast 1 for every 5 students
4	Plain table	Atleast 1 for every 5 students
5	Prismatic compass	6 Nos
6	Pocket stereoscope	1
7	Ranging rods	1 for a set of 5 student
8	Levelling staff	
9	Cross staff	
10	Chains	
11	Tapes	
12	Arrows	

P:30; TOTAL : 30 PERIODS

15CE41C

STRENGTH OF MATERIALS

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Recognize the concept of Energy principles (K3)
- CO2: Analyse structures as indeterminate (K3)
- CO3: Develop Knowledge on Columns (K3)
- CO4: Develop Knowledge on State of stress (K3)
- CO5: Develop Knowledge on Unsymmetrical bending and curved beams. (K3)
- CO6: Develop Knowledge on Cylinders and Shells (K3)

- UNIT I ENERGY PRINCIPLES 15**
Strain energy and strain energy density – strain energy in traction, shear in flexure and torsion – castigliano’s theorems – principle of virtual work – application of energy theorems for computing deflections in beams and trusses – Maxwell’s reciprocal theorems.
- UNIT II INDETERMINATE BEAMS 15**
Propped cantilever and fixed beams-fixed end moments and reactions for concentrated load (central, non central), uniformly distributed load, triangular load (maximum at centre and maximum at end) – theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams for continuous beams.
- UNIT III COLUMNS 15**
Eccentrically loaded short columns – middle third rule – core section – columns of unsymmetrical sections – (angle channel sections) – Euler’s theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – thick cylinders – compound cylinders.
- UNIT IV STATE OF STRESS IN THREE DIMENSIONS 15**
Spherical and deviatoric components of stress tensor - determination of principal stresses and principal planes – volumetric strain – dilatation and distortion – theories of failure – principal stress dilatation – principal strain – shear stress – strain energy and distortion energy theories – application in analysis of stress, load carrying capacity and design of members – residual stresses.
- UNIT V ADVANCED TOPICS IN BENDING OF BEAMS, CYLINDERS 15**
Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – curved beams – Winkler Bach formula – stress concentration – fatigue and fracture- thin cylinders and shells – under internal pressure – deformation of thin cylinders and shells-thick cylinders – compound cylinders.

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Bansal R.K. “Strength of materials”, Laxmi Publications, New Delhi, 2007.
2. Ramamrutham.S, “Strength of Materials”, DhanpatRai Publishing Company Private Limited, Jan-2008.

REFERENCES

1. Srinath, L.S. "Advanced mechanics and solids", Tata-McGraw Hill Publishing Company Limited, 2005.
2. Punmia B.C. "Theory of Structures (SMTS)" Vol 1&II, Laxmi Publishing Private Limited, New Delhi, 2004.
3. Rajput R.K. "Strength of Materials", S.Chand & Company Limited, New Delhi, 2006.

15CE42C APPLIED HYDRAULICS AND HYDRAULIC MACHINES L T P C 2 2 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain concepts of open channel flow, Channel transition and Identify Economical section (K2)
- CO2: Compute the flow measurement and specific energy (K2)
- CO3: Explain the rapidly varied channel-flow and dam flow profile characteristics (K2)
- CO4: Illustrate the performance characteristics of various types of turbines (K2)
- CO5: Examine the pumps for various engineering applications based on their performance Curves (K4)

UNIT I OPEN CHANNEL FLOW 12

Open channel flow – Types and regimes of flow – Velocity distribution in open channel — Determination of roughness coefficients – Manning's and Chezy's formula -Most economical sections – Wide open channel-channel transition.

UNIT II UNIFORM FLOW 12

Uniform flow – Flow measurement by notches and weirs – Specific energy– Determination of normal depth and velocity - Critical flow and its computation –Non-erodible channels.

UNIT III VARIED FLOW 12

Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and back water curves – Profile determination – Graphical integration, direct step and standard step method – Flow through transitions - Hydraulic jump – Types – Energy dissipation – Surges.

UNIT V TURBINES

12

Impact of jets on plane and curved plates - Application of momentum principle- - turbines - classification - radial flow turbines - axial flow turbines – Impulse and Reaction turbine- draft tube and cavitations.

UNIT V PUMPS

12

Centrifugal pump - minimum speed to start the pump – multistage Pumps – Jet and submersible pumps - Positive displacement pumps – Air lifting pumps- reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done - rotary pumps.

L: 30; T: 30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Ramamrutham S, “Hydraulics Fluid Mechanics and Fluid Machines”, Dhanpatrai Publishing Company, 2011.
2. Modi, P.N, and Seth S.M. “Hydraulic and Fluid Mechanics”, Standard Book House, 2011.

REFERENCES

1. Jain A.K., “Fluid Mechanics (including Hydraulic Machines)”, Khanna Publishers, 8th Edition, 1995.
2. Ranga Raju, K.G., “Flow through Open Channels”, Tata McGraw-Hill, 1985.
3. Bansal R.K, Fluid mechanics & Hydraulic machines, Laxmi Publishing Private Limited, New Delhi, 2007.

15CE43C	PROFESSIONAL ETHICS AND HUMAN	L	T	P	C
	VALUES	3	0	0	3
	(Common to all Programmes)				

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Recognize the core human values that shape the ethical behavior of an engineer. (K2)
- CO2: Expose awareness on professional ethics. (K2)
- CO3: Analyze the engineering ethical breach from past study. (K2)
- CO4: Distinguish and apply safety, responsibility and rights in workplaces. (K2)
- CO5: Discuss about the global issues with regard to ethics. (K2)

UNIT I HUMAN VALUES 9

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies.
Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Moral leadership - sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S and Senthil Kumar VS, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D and Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)

2. Charles E Harris, Michael S Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford 2001.

15CE44C

HIGHWAY ENGINEERING

L T P C

2 2 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Understand the highway planning, engineering surveys for highway alignment. (K3)
- CO2: Design the geometric features of highway elements (K6)
- CO3: Design the flexible and rigid pavements (K6)
- CO4: Identify the desirable properties of highway materials and its standards & various practices adopted for construction. (K3)
- CO5: Explain the skills on evaluation of the pavements and to decide appropriate types of maintenance (K2)

UNIT I HIGHWAY PLANNING AND ALIGNMENT 12

History of Road Construction, Highway Development in India - Jayakar Committee Recommendations and Realizations, Twenty-year Road Development Plans, Concepts of Ongoing Highway Development Programmes at National Level, Institutions for Highway Development at National level - Indian Roads Congress, Highway Research Board, National Highway Authority of India, Ministry of Road Transport and Highways (MORTH) and Central Road Research Institute. Requirements of Ideal Alignment, Factors Controlling Highway Alignment Engineering Surveys for Alignment - Conventional Methods and Modern Methods (Remote Sensing, GIS and GPS techniques) - Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements – Right of Way, Carriage Way, Camber, Krebs, Shoulders and Footpaths [IRC Standards], Cross sections of different Class of Roads - Principles of Highway Financing.

UNIT II GEOMETRIC DESIGN OF HIGHWAYS 12

Design of Horizontal Alignment – Horizontal Curves- Super elevation, Widening of Pavements on Horizontal Curves and Transition Curves. Design of Vertical Alignments – Rolling, Limiting, Exceptional and

Minimum Gradients, Summit and Valley Curves- Sight Distances – Factors affecting Sight Distances, PIEV theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance [Derivations and Problems in SSD and OSD] -Geometric Design of Hill Roads [IRC Standards Only].

UNIT III DESIGN OF FLEXIBLE AND RIGID PAVEMENTS 12

Rigid and Flexible Pavements- Components and their Functions -Design Principles of Flexible and Rigid Pavements, Factors affecting the Design of Pavements - ESWL, Climate, Sub-grade Soil and Traffic - Design Practice for Flexible Pavements [IRC Method and Recommendations - Problems] - Design Practice for Rigid Pavements – IRC Recommendations - concepts only.

UNITIV HIGHWAY MATERIALS AND CONSTRUCTION PRACTICES 12

Desirable Properties and Testing of Highway Materials: Soil – California Bearing Ratio Test, Field Density Test - Aggregate - Crushing, Abrasion, Impact Tests, Water absorption, Flakiness and Elongation indices and Stone polishing value test - Bitumen - Penetration, Ductility, Viscosity, Binder content and Softening point Tests. - Construction Practice - Water Bound Macadam Road, Wet Mix Macadam, Bituminous Road and Cement Concrete Road [as per IRC and MORTH specifications] - Highway Drainage [IRC Recommendations].

UNIT V HIGHWAY MAINTENANCE 12

Types of defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments. - Types of Pavement, Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural Cracks, Spalling of Joints and Mud Pumping – and Special Repairs. - Pavement Evaluation – Pavement Surface Conditions and Structural Evaluation, Evaluation of pavement Failure and strengthening - Overlay design by Benkelman Beam Method [Procedure only].

L: 30; T: 30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Khanna K and Justo C E G, “Highway Engineering”, Khanna Publishers, Roorkee, 10th Edition 2010.
2. Kadiyali L R, “Principles and Practice of Highway Engineering”, Khanna Technical Publications, Delhi, 2000.

REFERENCES

1. C.S. Papacostas, P.D. Prevedouros, "Transportation Engineering & Planning", Prentice Hall of India Pvt. Ltd., 2006.
2. IRC Standards (IRC 37 - 2001 & IRC 58 – 2002)
3. Bureau of Indian Standards (BIS) Publications on Highway Materials Specifications for Road and Bridges, MORTH (India)

15CE45C

ENGINEERING SURVEY- II

L T P C

2 2 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Utilize the concepts of curve for designing (K3)
- CO2 : Utilize the concepts of tacheometric surveying (K3)
- CO3: Utilize the concepts of control surveying (K3)
- CO4: Identify probable error and its adjustments in surveying measurements.(K3)
- CO5: Outline the concepts of celestial bodies and hydrological measurements by using astronomical and hydrographical surveying (K2)

UNIT I SETTING OUT OF CURVES

12

Curve ranging - Horizontal and vertical curves - Simple curves - Setting with chain and tapes, tangential angles by theodolite, double theodolite - Compound and reverse curves - Transition curves - Functions and requirements - Setting out by offsets and angles - Vertical curves - Sight distances.

UNIT II TACHEOMETRIC SURVEYING

10

Tachometric systems - Tangential, stadia and subtense methods - Stadia systems - Horizontal and inclined sights - Vertical and normal staffing - Fixed and movable hairs - Stadia constants – Anallatic lens - Subtense bar.

UNIT III CONTROL SURVEYING

12

Working from whole to part - Horizontal and vertical control methods - Triangulation - Signals - Base line - Instruments and accessories - Satellite station - Reduction to centre –Trilateration - Trigonometric leveling - Single and reciprocal observations – Bench marking.

UNIT IV SURVEY ADJUSTMENTS

12

Errors - Sources, precautions and corrections - Classification of errors -

True and most probable values - Weighted observations - Method of equal shifts - Principle of least squares - Normal equation - Correlates - Level nets - Adjustment of simple triangulation networks.

UNIT V ASTRONOMICAL AND HYDROGRAPHIC SURVEYING 14

Celestial sphere-Astronomical terms and definitions-Motion of sun and stars-Apparent altitude and corrections-Celestial co-ordinate systems-Nautical almanac-Star constellations -Practical astronomy - Field observations and calculations for azimuth- Hydrographic Surveying-Tides - MSL - Sounding methods - Location of soundings and methods - Three point problem - Strength of fix - Sextants and station pointer .

L: 30; T:30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Punmia B.C., "Surveying", Vols. I, II and III, Laxmi Publications, 2005.
2. Kanetkar T.P., "Surveying and Levelling", Vols. I and II, United Book Corporation, Pune, 2006.

REFERENCES

1. Clark D., "Plane and Geodetic Surveying", Vols. I and II, C.B.S. Publishers and Distributors, Delhi, 6th Edition, 2006.
2. James M.Anderson and Edward M.Mikhail, "Introduction to Surveying", McGraw-Hill Book Company, 2012.
3. Bannister A. and Raymond S., "Surveying", ELBS, 6th Edition, 2006.

15CE46C CONSTRUCTION MATERIALS, EQUIPMENTS AND PRACTICES

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Describe the Primary Construction materials and their properties. (K2)
- CO2: Describe the Secondary Construction materials and their properties. (K2)
- CO2: Illustrate the Construction Practices. (K2)
- CO3: Identify the Construction techniques. (K3)
- CO4: Utilize the construction equipments. (K3)

UNIT I PRIMARY CONSTRUCTION MATERIALS 9

Stones – Types – characteristics – uses - BIS tests - Tiles-types, selection, suitability, uses and maintenance – Bricks – composition –

manufacture – types - BIS tests. Hollow concrete blocks, Burnt clay hollow Blocks, Stabilized mud blocks – Selection of Building Blocks – Cement – Manufacturing – Different types - hydration- setting and hardening – Initial & Final Setting Time-Cement mortar

UNIT II SECONDARY CONSTRUCTION MATERIALS 9

Timber- defects-causes of decay - seasoning – preservation - fire proofing -Laminated wood products - types – properties – uses of fiber boards, particle boards, hard boards and A.C boards - Paints – types – wall paints – wood paints – metal paints. Steel Properties – types- Aluminum products - UPVC – crack fillers – Asbestos –GI Sheets– Glass – water proofing compounds – Neoprene – thermocole – fiber reinforced plastic – smart concrete and smart bricks.

UNIT III CONSTRUCTION PRACTICES 9

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

UNIT IV SPECIAL FORMS OF CONSTRUCTION 9

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation. Launching girders, bridge decks, off shore platforms -Material handling - erecting light weight components on tall structures.

UNIT V CONSTRUCTION EQUIPMENT 9

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

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. S.C. Rangawala, "Engineering materials", Charotar Publishing House, New Delhi.2014.
2. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", DhanpatRai and Sons, 2010.

REFERENCES

1. Shetty M.S., "Concrete Technology", S.Chand& Company, New Delhi, 2008.
2. Santhakumar. A.R, "Concrete Technology", Oxford University Press, 2007.

15CE47C HYDRAULIC ENGINEERING LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will able to

- CO1: Apply knowledge on flow measurements in pipes and open channels (K3)
- CO2: Calculate the performance on hydraulic machineries (K3)
- CO3: Apply knowledge on pipe layouts and design pumps for residential buildings (K3)
- CO4: Apply the knowledge of selecting pumps in different conditions. (K3)

LIST OF EXPERIMENTS

1. Determination of co-efficient of discharge for orifice
2. Determination of co-efficient of discharge for notches
3. Determination of co-efficient of discharge for venturimeter
4. Determination of co-efficient of discharge for orifice meter
5. Study of impact of jet on flat plate (normal / inclined)
6. Study of friction losses in pipes
7. Study of minor losses in pipes
8. Study on performance characteristics of Pelton turbine.
9. Study on performance characteristics of Francis turbine
10. Study on performance characteristics of Kaplan turbine
11. Study on performance characteristics of Centrifugal pumps (Constant / variable speed)
12. Study on performance characteristics of reciprocating pump.

LIST OF EQUIPMENTS
(For a batch of 30 students)

1. Bernoulli's theorem – Verification Apparatus
2. Flow Measurement open channel flow
 - i. Channel with provision for fixing notches (rectangular, triangular & trapezoidal forms)
 - ii. Flume assembly with provisions for conducting experiments on Hydraulic jumps, generation of surges etc.
3. Flow measurement in pipes
 - i. Venturimeter, U tube manometer fixtures like Valves, collecting tank
 - ii. Orifice meter, with all necessary fittings in pipe lines of different diameters
 - iii. Calibration of flow through orifice tank with Provisions for fixing orifices of different shapes, collecting tank
 - iv. Calibration of flow through mouth piece Tank with provisions for fixing mouth pieces Viz external mouth pieces & internal mouth piece Borda's mouth piece
4. Losses in Pipes
 - i. Major loss – Friction loss- Pipe lengths (min. 3m) of different diameters with Valves and pressure rapping & collecting tank
 - ii. Minor Losses - Pipe line assembly with provisions for having Sudden contractions in diameter, expansions Bends, elbow fitting, etc.
5. Pumps
 - i. Centrifugal pump assembly with accessories (single stage)
 - ii. Centrifugal pump assembly with accessories (multi stage)
 - iii. Reciprocating pump assembly with accessories
 - iv. Deep well pump assembly set with accessories
6. Turbine
 - i. Impulse turbine with assembly and fittings
 - ii. Francis turbine with assembly and fittings
 - iii. Kaplan turbine with assembly and fittings

P:30; TOTAL: 30 PERIODS

Unit I

Lab session:

- i) Listening to audio files :
 - Conversations
 - Speech
 - TED Talks

- ii) Listening and responding to any audio files:
 - Drawing the map
 - Picture completing task
 - Transferring data to Graph.

Practice session: On the spot Speaking activities: Just a minute speech, Picture description.

Unit II

Lab session: Read and understand the comprehension passages given in competitive examinations.

Practice session: Giving opinions and suggestions, analyzing a social issue.

Unit III

Lab session: Listening to audio files related to soft skills.

Practice session: Practicing Power point presentation, Group discussion and Interview skills.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Rizvi.M.Ashraf, "Effective Technical Communication", First Edition, The MC Graw Hill Education Private Limited, Companies, New Delhi, 2010.
2. Sangeetha Sharma and Binod Mishra, "Communication Skills for Engineers and scientists", PHI Learning Private Limited, Delhi, 2009.

15CE51C

STRUCTURAL ANALYSIS I

**L T P C
3 2 0 4**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Apply energy principles in simple problems (K3)
- CO2: Construct influence line diagrams for a structure (K3)
- CO3: Analyse hinged arches (K4)
- CO4: Analyse a structure using slope deflection method (K4)
- CO5: Analyse a structure using moment distribution method (K4)

- UNIT I DEFLECTION OF STRUCTURES 15**
Principle of virtual Forces – Castigliano’s First and Second Theorem – Theorem of least work – Clark Maxwell’s theorem of reciprocal deflection – Betti’s theorem – Application to simple problems of Statically determinate beams, trusses and frames.
- UNIT II MOVING LOADS AND INFLUENCE LINES 15**
(Determinate & Indeterminate Structures with Redundancy Restricted To One)
Construct Influence lines on reactions, shear force and bending moment for determinate beams and pin jointed frames.
Muller Breslau’s principle – Influence lines for continuous beams and single storey rigid frames
- UNIT III ARCHES 15**
Arches as structural forms –Types of arches – Analysis of three hinged and two hinged arches–Settlement and temperature effects.
- UNIT IV SLOPE DEFLECTION METHOD 15**
Continuous beams and rigid frames (Single storey, single bay with and without sway) – Symmetry and antisymmetry–Simplification for hinged end – Support displacements
- UNIT V MOMENT DISTRIBUTION METHOD 15**
Stiffness, carryover of moments and carry over factors – Analysis of continuous beams – Plane rigid frames (Single storey, single bay with and without sway) – Support displacements

L:45; T:30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Punmia B.C., “Theory of Structures” (SMTS) Vol II Laxmi Publishing Pvt. Ltd, New Delhi, 2004.
2. Vaidyanadhan, R and Perumal, P, “Comprehensive Structural Analysis – Vol. 1 & Vol. 2”, Laxmi Publications, New Delhi, 2003.

REFERENCES

1. C.K. Wang “Analysis of Indeterminate Structures”, Tata McGraw-Hill, 1992.
2. L.S. Negi & R.S. Jangid, “Structural Analysis”, Tata McGraw-Hill Publications, New Delhi, 6th Edition, 2003.
3. NPTEL

15CE52C DESIGN OF REINFORCED CONCRETE ELEMENTS L T P C
3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Design the reinforced concrete flexural members by working stress method and explain the different method of design.(K6)
- CO2: Design the reinforced concrete beams, slabs by limit state method. (K6)
- CO3: Design and identify the behavior of reinforced concrete subjected to bond, anchorage, shear and torsion by limit state method. (K6)
- CO4: Design the reinforced concrete columns by limit state method. (K6)
- CO5: Design the reinforced concrete footings by limit state method. (K6)

UNIT I METHODS OF DESIGN OF CONCRETE STRUCTURES 15

Materials for Concrete – Stress-Strain curve for concrete and reinforcing steel – Concept of Elastic method, ultimate load method and limit state method – Advantages of Limit State Method over other methods – Design codes and specification – Limit State philosophy as detailed in IS code – Design of flexural members and slabs by working stress method – Properties of un-cracked section

UNIT II LIMIT STATE DESIGN FOR FLEXURE 15

Analysis and design of one way and two way rectangular slab subjected to uniformly distributed load for various boundary conditions and corner effects – Analysis and design of singly and doubly reinforced rectangular, flanged and continuous beams

UNIT III LIMIT STATE DESIGN FOR BOND, ANCHORAGE, SHEAR AND TORSION 15

Behaviour of RC members in bond and anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending shear and torsion.

UNIT IV LIMIT STATE DESIGN OF COLUMNS 15

Types of columns – Braced and unbraced columns – Design of short column for axial, uniaxial and biaxial bending – Design of long columns.

UNIT V LIMIT STATE DESIGN OF FOOTING AND DETAILING 15

Design of wall footing – Design of axially and eccentrically loaded rectangular footing – Design of combined rectangular footing for two columns only – Standard method of detailing RC beams, slabs and columns

L:45; T:30;TOTAL: 75 PERIODS

TEXT BOOKS

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi 2002.
2. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi 2009.
3. Krishna Raju, N., "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi,2003.

REFERENCES

1. Jain, A.K., "Limit State Design of RC Structures", Nemchand Publications, Roorkee.
2. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi.

15CE53C WATER SUPPLY TREATMENT AND MANAGEMENT L T P C
3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Examine the various sources of water and their characteristics. (K4)
- CO2: Classify the different types of conveyance system, pipes and pumping system. (K4)
- CO3: Design the components of a water treatment plant. (K6)
- CO4: Explain the various processes of advance water treatment. (K5)
- CO5: Analyse distribution networks and water supply to buildings. (K4)

UNIT I PLANNING FOR WATERSUPPLY SYSTEM 15

Public water supply system - Planning - Objectives - Design period - Population forecasting -Water demand - Sources of water and their characteristics - Surface and Groundwater - Impounding reservoir well hydraulics - Development and selection of source - Water quality - Characterization -Water quality standards.

UNIT II CONVEYANCE SYSTEM 15

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

UNIT III WATER TREATMENT 15

Objectives - Unit operations and processes - Principles, functions design and drawing of flash mixers, flocculators, sedimentation tanks and sand filters – Filter press – Disinfection - Ozonation and UV - Residue Management – TSDF – Co-processing and co-incineration.

UNIT IV ADVANCED WATER TREATMENT 15

Aerator - Iron and manganese removal- Defluoridation and demineralization - Water softening - Desalination - membrane Systems – Construction, Operation & Maintenance aspects of Water Treatment Plants - Recent advances - Membrane Processes – Arsenic treatment.

UNIT V WATER DISTRIBUTION AND SUPPLY TO BUILDINGS 15

Requirements of water distribution - Components - Service reservoirs - Functions and drawings - Network design - Economics - Computer applications - Analysis of distribution networks - Appurtenances - operation and maintenance - Leak detection, methods- principles of design of water supply in buildings - House service connection - Fixtures and fittings - Systems of plumbing and drawings of types of plumbing.

L:45; T:30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2014.
2. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2010.
3. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Private Limited, New Delhi, 2014.

REFERENCES

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Syed R.Qasim and Edward M.Motley Guang Zhu, "Water Works Engineering Planning, Design and Operation", Prentice Hall of India Private Limited, New Delhi, 2006.
3. NPTEL

15CE54C

SOIL MECHANICS

L T P C
3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Classify the soil based on Index and Engineering properties (K4)
- CO2: Explain the principle of soil water movement and its effect on stress distribution (K2)
- CO3: Explain the stresses in the soil and principle of consolidation (K3)
- CO4: Determine the shear strength parameters of soil (K5)
- CO5: Analyse the stability of slopes and slope protection measures (K4)

UNIT I INTRODUCTION 15

Nature of Soil - Problems with soil - phase relation - sieve analysis - sedimentation analysis – Atterberg limits - Classification for engineering purposes - BIS Classification system - Soil compaction - factors affecting compaction – Field compaction methods and monitoring.

UNIT II SOIL WATER AND WATER FLOW 15

Soil water – Various forms – Influence of clay minerals – Capillary rise – Suction - Effective stress concepts in soil – Total, neutral and effective stress distribution in soil - Permeability – Darcy’s Law- Permeability measurement in the laboratory – Quick sand condition - Seepage – Laplace Equation - Introduction to flow nets –Properties and uses - Application to simple problems.

UNIT III STRESS DISTRIBUTION, COMPRESSIBILITY AND SETTLEMENT 15

Stress distribution in soil media – Boussinesque formula – Stress due to line load and Circular and rectangular loaded area - Approximate methods - Use of influence charts – Westergaard equation for point load - Components of settlement - Immediate and consolidation settlement - Terzaghi’s one dimensional consolidation theory – Governing differential equation - Laboratory consolidation test – Field consolidation curve – NC and OC clays - Problems on final and time rate of consolidation

UNIT IV SHEAR STRENGTH 15

Shear strength of cohesive and cohesionless soils - Mohr - Coulomb failure theory – Saturated soil - Strength parameters - Measurement of shear strength, direct shear, Triaxial compression, UCC and Vane shear tests –Types of shear tests based on drainage -Stress path (Concept only)

UNIT V SLOPE STABILITY

15

Slope failure mechanisms - Modes - Infinite slopes - Finite slopes – Total and effective stress analysis - Stability analysis for purely cohesive and C-soils - Method of slices – Modified Bishop’s method - Friction circle method - Stability number – Problems – Slope protection measures.

L:45; T:30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Punmia P.C., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd., New Delhi, 2005.
2. Gopal Ranjan and Rao A.S.R., “Basic and applied soil mechanics”, New Age International Publishers, New Delhi, 2000.
3. Venkatramaiah, C. “Geotechnical Engineering”, New Age International Publishers, New Delhi, 2010.
4. Khan I.H, “A text book of Geotechnical Engineering”, Prentice Hall of India, New Delhi, 1999.

REFERENCES

1. Coduto, D.P., “Geotechnical Engineering Principles and Practices”, Prentice Hall of India Private Limited, New Delhi, 2002.
2. McCarthy D.F., “Essentials of Soil Mechanics and Foundations Basic Geotechniques”, 6th Edition, Prentice-Hall, New Jersey, 2002.
3. Das, B.M, “Principles of Geotechnical Engineering”, (5th edition), Thomas Books/ cole, 2002
4. Muni Budhu, “Soil Mechanics and Foundations”, John Willey & Sons, Inc, New York, 2000.

15CE55C	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
	(Common to all Programmes)	3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain the concept of operational and project management. (K2)
- CO2: Define the scope of a project and develop the project plan. (K2)
- CO3: Evaluate the technical, business and social environment related to the project. (K3)
- CO4: Formulate and manage project team successfully. (K5)
- CO5: Monitor and control projects using tools and techniques. (K3)

UNIT I BASIC CONCEPT 9

Concept and categories of project - Project development cycle -
Concept, tools and techniques of project management - Logistics and
supply chain management - Forms of project organizations.

UNIT II PROJECT FORMULATION 9

Project identification, formulation and preparation. Market and demand
estimation - Market survey techniques - Demand forecasting. Materials
management - Analysis of materials input, technology, production, plant
capacity, location and site, civil works, charts, layouts and work
schedule. Cost of project - Means of financing, estimates of cost -
Financial projections.

UNIT III PROCESS OF PROJECT APPRAISAL 9

Technical, Economic, Financial, Legal and Social appraisal of the
Industrial Projects. Problems due to rate of discount, wage-rate,
exchange rates, treatment of taxes, social cost-benefits - treatment of
risk and uncertainty - sensitivity analysis and probability approach -
Single as well as multiple projects - Big data analytics - PLM and SLM.

**UNIT IV PROJECT TEAM FORMULATION AND
MAXIMIZING PARTICIPATION 9**

Project Team frame works - Project Team cultures - Barriers and
challenges - Selecting Team Members - Key skills of effective project
leaders - Giving / receiving feedback from different members of the
project.

**UNIT V IMPLEMENTATION, MONITORING AND
CONTROL OF PROJECTS 9**

Project scheduling, network techniques for resource, cost budgeting
and scheduling - project management teams and coordination -
Monitoring and post implementation, evaluation of the project - ERP -
Project financing.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gopalakrishnan P and Ramamoorthy VE "Textbook of Project Management", Macmillan Publications, 2014.
2. Maylor "Project Management", 3rd Edition, Pearson, 2010.

REFERENCES

1. Gido, "Effective project management", 3rd Edition, Cengage Learning, 2008.

V. TESTS ON AGGREGATES

- a. Proportioning of Aggregates
- b. Water Absorption & Specific gravity
- c. Aggregate Impact Value
- d. Aggregate Crushing value

VI. TESTS ON BITUMINOUS MIXES

- a. Determination of Binder Content
- b. Marshall Stability and Flow values

P:30; TOTAL: 30 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.NO	DESCRIPTION OF EQUIPMENTS	QUANTITY
1.	Concrete cube moulds	6
2.	Concrete cylinder moulds	3
3.	Concrete Prism moulds	3
4.	Sieves	1 set
5.	Concrete Mixer	1
6.	Slump cone	3
7.	Flow table	1
8.	Vibrator	1
9.	Trowels and planers	2 set
10.	Vee Bee Consistometer	1
11.	Aggregate impact testing machine	1
12.	Blains Apparatus	1
13.	Compression Testing Machine 200T capacity	1
14.	Flexure Testing Machine	1
15.	Compressometer	1
16.	Le Chatelier's apparatus	2
17.	Vicat's apparatus	2
18.	Mortar Cube moulds	6

15CE57C

SOIL MECHANICS LABORATORY

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Determine the index properties of soil. (K3)

CO2: Determine the engineering properties of soil. (K3)

LIST OF EXPERIMENTS

1. Grain size distribution - Sieve analysis.
2. Grain size distribution - Hydrometer analysis.
3. Specific gravity of soil grains.
4. Relative density of sands.
5. Atterberg limits test.
6. Determination of moisture - Density relationship using standard Proctor test.
7. Permeability determination (constant head and falling head methods).
8. Determination of shear strength parameters.
9. Direct shear test on cohesionless soil.
10. Unconfined compression test on cohesive soil.
11. Triaxial compression test (demonstration only).
12. One dimensional consolidation test (Demonstration only).
13. Field density test (Core cutter and sand replacement methods).

P: 30; TOTAL: 30 PERIODS

LIST OF EQUIPMENTS

(FOR A BATCH OF 30 STUDENTS)

SI. No.	DESCRIPTION OF EQUIPMENTS	QUANTITY
1.	Sieves	2 sets
2.	Hydrometer	2 sets
3.	Liquid and plastic limit apparatus	2 sets
4.	Shrinkage limit apparatus	3 sets
5.	Proctor compaction apparatus	1 set
6.	CBR Apparatus	1
7.	Direct shear apparatus	1
8.	Thermometer	2
9.	Field density measuring device	2
10.	Triaxial shear apparatus	1
11.	Three gang consolidation test device	1

15CE61C DESIGN OF STEEL STRUCTURES L T P C
3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Design simple, eccentric connections. (K6)
- CO2: Design tension members by appropriate identification of structural steel. (K6)
- CO3: Design compression members by appropriate identification of structural steel. (K6)
- CO4: Design the members subjected to bending and Lateral torsional buckling. (K6)
- CO5: Design the components of Industrial roofing and its components. (K6)

UNIT I INTRODUCTION 15

Properties of steel – Structural steel sections – Limit State Design Concepts – Loads on Structures – Metal joining methods using rivets, welding, bolting – Design of bolted, riveted and welded joints – Eccentric connections - Efficiency of joints – High Tension bolts

UNIT II TENSION MEMBERS 13

Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shear lag

UNIT III COMPRESSION MEMBERS 17

Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base

UNIT IV BEAMS 15

Types of simple beam connections – Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders riveted and welded – Intermediate and bearing stiffeners – Web splices

UNIT V ROOF TRUSSES AND INDUSTRIAL STRUCTURES 15

Roof trusses – Roof and side coverings – Design loads – design of purlin and elements of truss for simple trusses– end bearing – Design of gantry girder and gantry columns

L: 45; T 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Dayaratnam.P, "Design of Steel Structures", 2nd Edition, S. Chand & Company, 2003.
2. Ramachandra.S and Virendra Gehlot, "Design of Steel Structures – Vol. I & II", Standard Publication, New Delhi, 2007
3. Bhavikatti.S.S., "Design of steel Structures", I.K. International Private Limited, 2009.

REFERENCES

1. "Teaching Resources for Structural Steel Design – Vol. I & II", INSDAG, Kolkatta.
2. Gaylord, E.H., Gaylord, N.C., and Stallmeyer, J.E., "Design of Steel Structures", 3rd Edition, McGraw-Hill Publications, 1992.
3. Negi L.S., Design of Steel Structures, Tata McGraw Hill Publishing Private Limited, New Delhi, 2007.

15CE62C

STRUCTURAL ANALYSIS II

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain the concepts of flexibility method and apply it for the analysis of indeterminate structures. (K4)
- CO2: Explain the concepts of stiffness method and apply it for analysis of indeterminate structures (K4)
- CO3: Make use of the fundamental theory of FEA method. (K4)
- CO4: Analyse structure using plastic mechanism. (K4)
- CO5: Analyse space trusses and suspension cables and bridges. (K4)

UNIT I FLEXIBILITY MATRIX METHOD

15

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

UNIT II STIFFNESS MATRIX METHOD

15

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

UNIT III FINITE ELEMENT METHOD 15

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

UNIT IV PLASTIC ANALYSIS OF STRUCTURES 15

Statically indeterminate axial problems – Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.

UNIT V SPACE AND CABLE STRUCTURES 15

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

L:45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Bhavikatti, S.S, “Structural Analysis – Vol. 1, Vol. 2”, Vikas Publishing House Private Limited, New Delhi, 2008
2. L.S. Negi & R.S. Jangid, “Structural Analysis”, Tata McGraw-Hill Publications, New Delhi, 2003.

REFERENCES

1. Vaidyanathan.R and Perumal.P, “Comprehensive structural Analysis – Vol. I & II”, Laxmi Publications, New Delhi, 2003
2. Ghali.A, Nebille,A.M. and Brown,T.G. “Structural Analysis - A unified classical and Matrix approach” –5th Edition. Spon Press, London and New York, 2003.
3. Coates R.C, Coutie M.G. and Kong F.K., “Structural Analysis”, ELBS and Nelson, 1990
4. G.S. Pandit & S.P. Gupta, “Structural Analysis – A Matrix Approach”, Tata McGraw Hill, 2004.

**15CE63C FOUNDATION ENGINEERING L T P C
3 2 0 4**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Plan site investigation program to select type of foundation. (K2)
- CO2: Determine bearing capacity of shallow foundation based on the soil conditions. (K5)

CO3: Examine raft and footings based on contact pressure distribution. (K4)

CO4: Explain the load carrying capacity and settlement of piles and pile group. (K2)

CO5: Illustrate the behavior of soil behind retaining structures. (K2)

UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 15

Scope and objectives – Methods of exploration-Auguring and boring – Water boring and rotatory drilling – Geophysical methods- Depth of boring – Spacing of bore hole - Sampling – Representative and undisturbed sampling – Sampling techniques – Split spoon sampler, Thin tube sampler, Stationary piston sampler – Bore log report – Penetration tests (SPT and SCPT) – Data interpretation (Strength Parameters and Liquefaction potential) – Selection of foundation based on soil condition

UNIT II SHALLOW FOUNDATION 15

Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – factors affecting bearing capacity – Problems - Bearing Capacity from insitu tests (SPT, SCPT and plate load) – Allowable bearing pressure, Settlement – Components of settlement – Determination of settlement of foundations on granular and clay deposits – Allowable settlements – Codal provision – Methods of minimising settlement, differential settlement.

UNIT III FOOTINGS AND RAFTS 15

Types of foundation – Contact pressure distribution below footings and raft - Isolated and combined footings – Types and proportioning - Mat foundation– Types, applications uses and proportioning-principle of floating foundation.

UNIT IV PILES 15

Types of piles and their function – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil - Static formula - Dynamic formulae (Engineering news and Hiley's) – Capacity from insitu tests (SPT and SCPT) – Negative skin friction – Uplift capacity – Group capacity by different methods (Feld's rule, Converse Labarre formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test – Forces on pile caps – Under reamed piles – Capacity under compression and uplift.

UNIT V RETAINING WALLS 15

Plastic equilibrium in soils – Active and passive states – Rankine's theory

– Cohesionless and cohesive soil - Coloumb's wedge theory – Condition for critical failure plane - Earth pressure on retaining walls of simple configurations – Graphical methods (Rebhann and Culmann) - Pressure on the wall due to line load – Stability of retaining walls.

L:45; T :30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 2005.
2. Murthy, V.N.S, "Soil Mechanics and Foundation Engineering", UBS Publishers Distribution Ltd, New Delhi, 2009.
3. Gopal Ranjan and Rao, A.S.R."Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi (India), 2006.

REFERENCES

1. Das, B.M. "Principles of Foundation Engineering (5th edition), Thomson Books / COLE, 2013
2. Bowles J.E, "Foundation analysis and design", McGraw-Hill, 2001
3. Venkatramaiah,C."Geotechnical Engineering", New Age International Publishers, New Delhi, 2014

15CE64C WASTE WATER TREATMENT AND MANAGEMENT

**L T P C
3 2 0 4**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Examine the various sources of waste water and their characteristics (K4)
- CO2: Design the sewer system and classify the pumps and plumbing system (K6)
- CO3: Design the components of primary treatment of a waste water treatment plant (K6)
- CO4: Design the components of secondary treatment of a waste water treatment plant (K6)
- CO5: Explain the various methods of sludge and sewage disposal (K2)

UNIT I PLANNING FOR SEWERAGE SYSTEMS 15

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

UNIT II SEWER DESIGN 15

Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Small bore systems - Computer applications – Laying, joining & testing of sewers – appurtenances – Pumps – selection of pumps and pipe Drainage - Plumbing System for Buildings – One pipe and two pipe system.

UNIT III PRIMARY TREATMENT OF SEWAGE 15

Objective – Unit Operation and Processes – Selection of treatment processes – Onsite sanitation - Septic tank – Primary treatment – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Operation and Maintenance aspects.

UNIT IV SECONDARY TREATMENT OF SEWAGE 15

Objective – Aerobic and Anaerobic treatment - Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter, other treatment methods – Oxidation ditches, UASB –Biomethanisation and Gobar gas plant - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants - Online monitoring system

UNIT V DISPOSAL OF SEWAGE AND SLUDGE 15

Standards for Disposal – Methods – Self purification of surface water bodies – Oxygen sag curve– Soil dispersion system - Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Composting (Vermi)- Advances in Sludge Treatment and disposal.

L:45; T:30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Garg, S.K., “Environmental Engineering Vol. II”, Khanna Publishers, New Delhi, 2014.
2. Punmia, B.C., Jain, A.K., and Jain.A., “Environmental Engineering, Vol.II”, Lakshmi Publications, Newsletter, 2014.

REFERENCES

1. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2014.
2. Metcalf and Eddy., “Wastewater Engineering – Treatment and Reuse”, Tata McGraw Hill Company, New Delhi, 2015.

15CE65C ESTIMATION AND QUANTITY SURVEYING L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Estimate quantities of various components of a building (K5)
- CO2: Estimate quantities of septic tank, road, culvert, Irrigation structures (K5)
- CO3: Analyze the rates of constructions and describe the specifications (K4)
- CO4: Estimate the value of the building (K5)
- CO5: Develop the report for various structures (K3)

UNIT I ESTIMATE OF BUILDINGS 9

Load bearing and Framed structures – Calculation of quantities of Earthwork, PCC, Brick work, RCC, Plastering for Residential building and shops– Various types of arches – Calculation of brick work and RCC works in arches

UNIT II ESTIMATE OF OTHER STRUCTURES 9

Estimating of septic tank, soak pit — Open well – Estimate of bituminous and cement concrete roads – Estimate of retaining walls – culverts – Estimating of irrigation works – aqueduct, fall.

UNIT III ANALYSIS OF RATES, SPECIFICATIONS AND TENDERS 9

Data – Schedule of rates – Analysis of rates – Specifications – Detailed and general specifications – Tenders – Contracts – Types of contracts – Arbitration and legal requirements.

UNIT IV VALUATION 9

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

UNIT V REPORT PREPARATION 9

Principles for Report Preparation – Report on Estimate of residential building – Culvert – Roads – Water supply and sanitary installations

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

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

REFERENCE

1. PWD Data Book.

15CE66C ENVIRONMENTAL ENGINEERING LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Determine the quality parameters of water (K4)
- CO2: Determine the quality parameters of sewage (K4)

LIST OF EXPERIMENTS

1. Sampling, Preservation methods and Characterisation of water and sewage.
2. Determination of pH and Electrical Conductivity
3. Determination of Turbidity and Hardness
4. Determination of Iron & Fluoride
5. Determination of Residual Chlorine
6. Determination of Chloride
7. Determination of Sulphate
8. Determination of Optimum Coagulant Dosage
 - i) Alum dozing
 - ii) Lime dozing
9. Determination of available Chlorine in Bleaching powder
10. Determination of Dissolved Oxygen
11. Determination of Solids
12. C.O.D. test
13. B.O.D. test
14. Determination of Ammonia Nitrogen
15. Determination of Total Nitrogen.
16. Introduction to Bacteriological Analysis (Demonstration only)

P:30; TOTAL: 30 PERIODS

LIST OF EQUIPMENTS
(FOR A BATCH OF 30 STUDENTS)

1	pH meter	-	1 No.
2	Turbidity meter	-	1 No.
3	Conductivity meter	-	1 No.

4	Refrigerator	-	1 No.
5	BOD incubator	-	1 No.
6	Muffle furnace	-	1 No.
7	Hot air oven	-	1 No.
8	Magnetic stirrer with hot plates	-	1 No.
9	Desicator	-	1 No.
10	Jar test apparatus	-	1 No.
11	Water bath	-	1 No.
12	Furniture	-	1 lot
13	Glass wares / Crucibles	-	1 lot
14	COD apparatus	-	1 No
15	Kjeldane apparatus	-	1 No.
16	Calorimeter	-	1 No.
17	Chlorine comparator	-	1 No.
18	Beaker	-	30 Nos.
19	Standard Flask	-	30 Nos.
20	Burette with stand	-	15 Nos.
21	Pipette	-	15 Nos.
22	Crucible	-	15 Nos.
23	Filtration assembly	-	1 No.
24	Chemicals	-	1 lot
25	Chemical balance	-	1 No.

15CE67C SOFTWARE APPLICATIONS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Design various elements of Retaining wall / Water tanks / Truss / Framed Structures. (K6)
- CO2: Sketch structural drawings using AutoCAD of a various elements of Retaining wall / Water tanks/Truss/Framed Structures. (K3)
- CO3: Analyze truss/framed structures using Analyzing software (K6)

LIST OF EXPERIMENTS

1. Design and detailing of Reinforced Cement Concrete cantilever and counterfort type retaining walls with reinforcement details.
2. Design of solid slab and Reinforced Cement Concrete Tee beam bridges for Indian Road Congress loading and reinforcement details.
3. Design and detailing of over head water tank, circular and rectangular water tanks.
4. Analysis and design of a three dimensional truss system using an analysing software.
5. Analysis and design of multi storied framed structure using an analysing software.

P:30; TOTAL: 30 PERIODS

LIST OF EQUIPMENTS

1. Computer Pentium IV	-	30
2. Drafting Software	-	1
3. Analysing and design software	-	1

15CE68C PRODUCT DEVELOPMENT LABORATORY L T P C
0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: understand the integration of customer requirements in product design.
- CO 2: Apply structural approach to concept generation, selection and testing.
- CO 3: Understand various aspects of design such as industrial design, design for manufacture.

The objective of this course is to make the students learn methodologies for identifying customer needs, developing new product concepts, prototype development, estimation of manufacturing costs, and developing business plans to support the development and marketing of these products. A student or a team of students shall develop their own products based on the users need, build simple prototypes of their design, and write development plans for the products.

P: 60 TOTAL: 60 PERIODS

15CE71C CONSTRUCTION PROJECT MANAGEMENT L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Outline the features of construction industry (K2)
- CO2: Develop the planning for construction project (K3)
- CO3: Develop Scheduling for construction project (K3)
- CO4: Explain the resource management in construction (K3)
- CO5: Explain the cost control in construction project efficiently (K3)

UNIT I INTRODUCTION TO CONSTRUCTION INDUSTRY 9

Introduction- Construction Industry - Project Participants - Characteristics of projects- Project life cycle - Construction Organization - Contracts- Work Breakdown Structure.

UNIT II PROJECT PLANNING MANAGEMENT 9

Estimating project time and cost planning - Developing a network plan - Bar chart - Activity on Arrow (AOA) - Activity on Node (AON) - Precedence network- Introduction to computer software MS PROJECT and PRIMAVERA

UNIT III SCHEDULING MANAGEMENT 9

Scheduling - Network analysis- Start and finish time – Floats - Critical path Project Update - Project Controls - Schedule Compression- Cost-Time Trade Off (Network Crashing).

UNIT IV MANAGEMENT OF RESOURCES 9

Resource Management - Resource Scheduling - Construction Procurement - Inventory control – Equipment management - Material management.

UNIT V COST CONTROL MANAGEMENT 9

Cost Management – Introduction to financial management - Quality management and safety - Site Management & Administration.

L: 45; TOTAL 45 PERIODS

TEXT BOOKS

1. Vazirani V.N. & Chandola S.P., "Heavy Construction", Khanna Publications.
2. Jha J. & Sinha S.K., "Construction & Foundation Engineering", Khanna Publications.

REFERENCES

1. Verma L.C., Standardisation - A New Discipline Peurifoy R.L.,& Ledbetter W.B., Construction Planning Equipment & Methods.
2. K.K.Chitkara, "Construction Project Management", Tata McGraw-Hill Education, 1998

15CE72C

MINI PROJECT

L T P C

0 0 8 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Apply the design skills in solving engineering problems. (K3)

CO2: Prepare design reports in a standard format. (K6)

P: 120 TOTAL: 120 PERIODS

15CE73C RESEARCH PAPER AND PATENT REVIEW – SEMINAR

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Summarize a review article, research article, thesis chapter and other related academic research text (K2)

CO2: Outline proposals for patent (K2)

COURSE CONTENT

The course is designed to cover techniques that can be applied to different types of academic writing including essays, reviews, research papers, grant proposals, patents and thesis writing. The participants will practice these techniques by drafting a research article with support from other class members and the instructor.

P: 30 TOTAL: 30 PERIODS

15CE74C

COMPREHENSION

L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: recollect engineering knowledge acquired during earlier semesters. (K2)

CO2: improve engineering knowledge to face competitive examinations. (K2)

Assessment procedure

- Review of civil engineering course of earlier semesters will be done by conducting objective type tests.
- Periodically competitive exam level objective type tests will be conducted and evaluated.
- Comprehensive viva will be conducted at the end of the semester for the revised courses.

P: 30 TOTAL: 30 PERIODS

15CE81C

PROJECT WORK

L T P C
0 0 20 10

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Apply their analyzing and designing skills for engineering problems. (K3)

CO2: Practice self learning through proper application of their previously acquired knowledge. (K4)

CO3: Synchronies themselves to work with a team (K5)

CO4: Prepare a complete set of report in a standard format (K6)

P: 300; TOTAL: 300 PERIODS

15CE82C INTERNSHIP / INPLANT TRAINING

**L T P C
0 0 4 2**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: recognize the requirement of the industry and cope up with the industrial scenario (K2)
- CO2: prepare a report about the work experience in industry. (K3)
- CO3: explain effectively through technical presentation. (K2)

COURSE DESCRIPTION

A. INTERNSHIP

- Internship undergone in R&D organization and reputed institution.
- An Evaluation committee formed by the HOD will review and the marks are awarded as follows: Internship Report (40%), Presentation (30%) and oral Examination (30%)

B. INPLANT TRAINING

- 2 to 4 weeks Training undergone in industries and also in R&D organization are considered as inplant training.
- An Evaluation committee formed by the HOD will review and the marks are awarded as follows: Inplant Training Report (40%), Presentation (40%) and Oral Examination (20%)

P: 60; TOTAL: 60 PERIODS

15CE01E

BRIDGE STRUCTURES

L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

CO1: Examine the type of bridge and its basic requirements for particular location (K4)

CO2: Design the simple kind of bridge structures (K6)

CO3: Design the T- beam concrete bridge structures (K6)

CO4: Design the Steel and Steel Concrete Composite Bridge sections (K6)

CO5: Design the Supporting Structures for Bridges (K6)

UNIT I INTRODUCTION

9

Investigations and planning, choice of type, linear water way, economic span length, IRC specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

UNIT II SIMPLE BRIDGE STRUCTURES

9

Load Calculation and dispersion -Design of Slab Bridges – Box Culvert- Pipe Culvert.

UNIT III T- BEAM CONCRETE BRIDGES

9

Pigaud's theory, courbon's theory- T-Beam Bridges, Prestressed Concrete Bridges.

UNIT IV STEEL AND STEEL CONCRETE COMPOSITE BRIDGES

9

Plate Girder Bridges – Steel Concrete Composite Bridges.

UNIT V SUPPORTING STRUCTURES

9

Abutments – Piers – Foundations – Bearings.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi, 2008.
2. Rajagopalan, N "Bridge Superstructure", Alpha Science International, 2006

REFERENCES

1. Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 1990.
2. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi, 1996.

3. David A. Sheppard, William R. and Philips, "Plant Cast precast and prestressed concrete - A design guide", McGraw Hill, New Delhi 1992.

15CE03E

THEORY OF PLATES

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Analyse bending of long rectangular plates using thin plate theory. (K4)
- CO2: Analyse circular plates with various loading conditions. (K4)
- CO3: Analyse rectangular plates using classical approach and methods. (K4)
- CO4: Analyse rectangular plates using finite difference method. (K4)
- CO5: Analyse bending of Anisotropic plates. (K4)

UNIT I THIN PLATE THEORY

9

Assumptions – Bending of long rectangular plates to a cylindrical surface – Differential equation – Plates with simply supported edges – Plates with built-in edges – Pure bending of plates – Slope and curvature of slightly bent plates – Relation between bending moment and curvature.

UNIT II CIRCULAR PLATES

9

Symmetrical bending of laterally loaded circular plates – Differential equation – Uniformly loaded circular plates – Circular plate with triangular loading – Circular plate with circular hole – Circular plate concentrically loaded – Circular plate loaded at the centre – Circular plates with moments.

UNIT III CLASSICAL APPROACH AND METHODS

9

Small deflections of laterally loaded plates – Differential equation of the deflection surface – Simply supported rectangular plates under sinusoidal loading – Navier's solution for simply supported rectangular plates under uniform loading, under hydrostatic pressure, under concentrated load and under a load uniformly distributed over the area of a rectangle - Levy's method – Advantages over Navier's solution – Simply supported rectangular plates under uniform loading and under hydrostatic pressure.

UNIT IV FINITE DIFFERENCE APPROACH

9

Bending of laterally loaded thin plates – Differential equation – Simply

supported and fixed square and rectangular plates under uniform loading, partial loading, triangular loading and trapezoidal loading - Energy methods - Principle of virtual work - Principle of minimum potential energy.

UNIT V ANISOTROPIC PLATES 9

Bending of Anisotropic plates – Differential equation of the bent plate – Bending of rectangular plates – Bending of circular and elliptical plates.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. J.N. Reddy, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2006.
2. K. Chandrashekhara, "Theory of Plates," University Press (India) Ltd., Hyderabad, 2001.

REFERENCES

1. S.Timoshenko and S.W.Kruger "Theory of plates and Shells," McGraw Hill Book Company, New York, 2008.

**15CE04E TALL BUILDINGS L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Define the various loads acting on a tall building. (K2)
CO2: Describe the forces and frames of tall building. (K2)
CO3: Outline the common high rise structures. (K2)
CO4: Analyse a tall structure. (K4)
CO5: Explain the techniques used in high-rise buildings. (K6)

UNIT I INTRODUCTION 9

The Tall Building in the Urban Context - The tall building and its support structure - development of high rise building structures - General Planning Considerations. Dead Loads - Live Loads-Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading – Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads.

UNIT II THE VERTICAL STRUCTURE PLANE 10

Dispersion of Vertical Forces- Dispersion of Lateral Forces - Optimum Ground Level Space - Shear Wall Arrangement - Behaviour of Shear

Walls under Lateral Loading. The Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing- Composite Floor Systems The High – Rise Building as related to assemblage Kits Skeleton Frame Systems - Load Bearing Wall Panel Systems - Panel – Frame Systems - Multistory Box Systems.

UNIT III COMMON HIGH RISE STRUCTURES 10

The Bearing Wall Structure- The Shear Core Structure - Rigid Frame Systems- The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss - Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms - Dynamic Response.

UNIT IV APPROXIMATE STRUCTURAL ANALYSIS AND DESIGN OF BUILDINGS 9

Approximate Analysis of Bearing Wall Buildings The Cross Wall Structure - The Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading - Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings - Shear Wall Structure - Vierendeel Structure - The Hollow Tube Structure.

UNIT V OTHER HIGH-RISE BUILDING STRUCTURE 7

Deep - Beam Systems – High rise suspension systems - Pneumatic High rise buildings - Space Frame Applied to High rise Buildings - Capsule Architecture.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Wolfgang Schueller "High - rise building Structures", John Wiley and Sons, New York 1986.
2. Bryan Stafford Smith and Alex Coull, "Tall Building Structures", Analysis and Design, John Wiley and Sons, Inc., 2011.

REFERENCES

1. Coull, A. and Smith, Stafford, B, "Tall Buildings ", Pergamon Press, London, 1997.
2. LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994.
3. Taranath.B.S., Structural Analysis and Design of Tall Buildings, McGraw Hill,1998

REFERENCES

1. Koncz T., "Manual of precast concrete construction, Vols. I, II and III", Bauverlag, GMBH, 1971.
2. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.

15CE06E COMPUTER AIDED DESIGN OF STRUCTURES L T P C 3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Formulate algorithm for solving equations by matrix method and construct algorithm for computer aided design of truss problems. (K6)
- CO2: Construct algorithm for computer aided design of reinforced concrete members. (K6)
- CO3: Construct algorithm for computer aided design of steel members. (K6)
- CO4: Construct algorithm for analysis of prestressed concrete members. (K6)
- CO5: Outline a computer aided analysis and design software. (K2)

UNIT I STRUCTURAL ANALYSIS 9

Banded and semi-banded matrices - element stiffness matrix – structure stiffness matrix –algorithm for solving trusses by matrix stiffness method.

UNIT II REINFORCED CONCRETE STRUCTURES 9

Stress-strain relationship in concrete and steel – algorithm for bending moment coefficients in slab – algorithm for developing design tables for beams – rectangular and flanged sections.

UNIT III STEEL STRUCTURES 9

Algorithm for finding load carrying capacity of steel columns – algorithm for moment carrying capacity of steel beams.

UNIT IV PRESTRESSED CONCRETE STRUCTURES 9

Algorithm for analysis of prestressed rectangular and I sections in flexure – algorithm for finding losses in prestress.

UNIT V SOFTWARE APPLICATIONS 9

Introduction to Analyzing software – Software working - Optimization – Application software.

L :45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Groover M.P. and Zimmers E.W. Jr., "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Limited, New Delhi, 2014.
2. Krishnamoorthy C.S.Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi, 2003

REFERENCES

1. Harrison H.B., "Structural Analysis and Design, Part I and II" Pergamon Press, Oxford, 1990.
2. Rao S.S., "Optimisation Theory and Applications", Wiley Eastern Limited, New Delhi, 1977.
3. Richard Forsyth (Ed), "Expert System Principles and Case Studies", Chapman and Hall, London, 1989.

15CE07E

INDUSTRIAL STRUCTURES

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Construct the planning aspects of the Industrial Buildings. (K3)
- CO2: Select functional Requirement of the Industrial Buildings. (K3)
- CO3: Develop Steel Structures for Industries. (K6)
- CO4: Develop Concrete Structures for Industries. (K6)
- CO5: Explain the concept of Prefabrications in Industries. (K4)

UNIT I PLANNING

9

Classification of Industries and Industrial structures – General requirements for industries like cement, chemical and steel plants – Planning and layout of buildings and components.

UNIT II FUNCTIONAL REQUIREMENTS

9

Lighting – Ventilation – Acoustics – Fire safety – Guidelines from factories act.

UNIT III DESIGN OF STEEL STRUCTURES

9

Industrial roofs – Crane girders – Mill buildings – Design of Bunkers and Silos

UNIT II MEASURING TECHNIQUES 9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT III SENSORS 9

Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVDT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV ACTUATORS 9

Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro rheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials.

UNIT V APPLICATIONS TO CIVIL ENGINEERING 9

Signal Processing and Control for Smart Structures – Sensors for Civil Engineering Structures – Damage detection using sensors – Smart Buildings–Smart Building components such as smart windows.

L: 45; TOTAL: 45 PERIODS

TEXT BOOK

1. Brain Culshaw, "Smart Structure and Materials" Artech House Borton, London 1996.

REFERENCES

1. L. S. Srinath, "Experimental Stress Analysis" Tata McGraw-Hill, 1998.
2. J. W. Dally & W. F. Riley, "Experimental Stress Analysis", Tata McGraw-Hill, 1998.

15CE09E REPAIR AND REHABILITATION OF STRUCTURES L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain the concepts of Maintenance and assessment procedure. (K2)
- CO2: Infer on the effects of durability of concrete. (K2)
- CO3: Interpret various materials for repair. (K2)

CO4: Select suitable techniques for repair of concrete structures. (K4)

CO5: Indicate the suitable retrofit to overcome the repairs. (K2)

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE 11

Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking.

UNIT III MATERIALS FOR REPAIR 9

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

UNIT IV TECHNIQUES FOR REPAIR AND DEMOLITION 8

Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. Engineered demolition techniques for dilapidated structures - case studies.

UNIT V REPAIR OF STRUCTURES WITH CASE STUDIES 8

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
2. R.T.Allen and S.C.Edwards, "Repair of Concrete Structures", Blakie and Sons, UK, 1987

REFERENCES

1. M.S.Shetty, "Concrete Technology - Theory and Practice", S.Chand and Company, New Delhi, 2014.

UNIT III FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS 10

Plane trusses – Local –Global transformation - Stiffness matrix – Stress calculations.

UNIT IV FINITE ELEMENT ANALYSIS OF TRUSS PROBLEMS 8

Plane trusses – Local –Global transformation - Stiffness matrix – Stress calculations.

UNIT V APPLICATIONS OF FEA IN SOFTWARES 8

Introduction to FEA Software – ANSYS, ABAQUS- Modeling-Mesh Generation – Adaptive Mesh Generation – Analysis.

L:45; TOTAL: 45 PERIODS

TEXT BOOK

1. Chandrupatla, T.R., and Belegundu, A.D., "Introduction to Finite Element in Engineering", 3rd Edition, Prentice Hall, India, 2003.

REFERENCES

1. J.N.Reddy, "An Introduction to Finite Element Method", McGraw-Hill, Intl. Student Edition, 2005.
2. Zienkiewics, "The finite element method, Basic formulation and linear problems", Vol.1, 4th Edition, McGraw-Hill, Book Co 1998.
3. S.S.Rao, "The Finite Element Method in Engineering", Pergaman Press, 2003.

15CE11E DESIGN OF REINFORCED CONCRETE AND BRICK L T P C MASONRY STRUCTURES 3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Design the retaining walls. (K6)
- CO2: Design the water tanks. (K6)
- CO3: Design staircase, flat slabs, concrete walls. (K6)
- CO4: Design slabs using yield line theory. (K6)
- CO5: Design brick walls. (K6)

UNIT I RETAINING WALLS 9

Retaining wall – Types – Design and detailing of cantilever and counter fort retaining walls.

UNIT II WATER TANKS 9

Design – Underground rectangular tanks – Domes – Overhead circular and rectangular tanks – Design of staging and foundations.

UNIT III STAIRCASES, FLAT SLABS, RC WALLS 9

Staircase – Types – Design of staircases (ordinary and doglegged) – Design of flat slabs – Design of Reinforced concrete walls.

UNIT IV YIELD LINE THEORY 9

Application of virtual work method to square, rectangular, circular and triangular slabs

UNIT V BRICK MASONRY 9

Introduction - Classification of walls -Lateral supports and stability - Effective height of wall and columns - Effective length of walls - design loads, load dispersion, permissible stresses - Design of axially and eccentrically loaded brick walls..

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Unnikrishna Pillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw-Hill Publishing Company Limited, New Delhi 2009.
2. Dayaratnam, P., “Brick and Reinforced Brick Structures”, Oxford & IBH Publishing House, 2006.
3. Varghese, P.C., “Advanced Reinforced Concrete Structures”, Prentice Hall of India Private Limited, New Delhi, 2007.

REFERENCES

1. Mallick, D.K. and Gupta A.P., “Reinforced Concrete”, Oxford and IBH Publishing Company, 2007
2. Krishna Raju, N., “Design of RC Structures”, CBS Publishers and Distributors, Delhi, 2006
3. Ram Chandra.N. and Virendra Gehlot, “Limit State Design”, Standard Book House, 2004.

**15CE12E PRESTRESSED CONCRETE L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Examine the basics and behavior of prestressed concrete. (K4)
- CO2: Estimate the concepts of Limit state of serviceability. (K5)

- CO3: Estimate the Limit state of strength. (K5)
CO4: Design of prestressed circular tanks and pipes. (K6)
CO5: Analyse the prestressed composite structures. (K6)

UNIT I	ANALYSIS OF STRESSES	9
Systems and methods of prestressing – Analysis of sections using three concepts		
UNIT II	LIMIT STATE OF SERVICABILITY	9
Calculation of Short term and long term deflections - Losses in pretensioned and post tensioned members – Estimation of crack width		
UNIT III	LIMIT STATE OF STRENGTH	9
Flexural, Shear, Torsional Strength of Prestressed Concrete Beams - Design of End block		
UNIT IV	CIRCULAR PRESTRESSING	9
Design of prestressed concrete tanks – fixed & hinged base – Pipes		
UNIT V	COMPOSITE CONSTRUCTION	9
Analysis for stresses – Differential shrinkage – Deflections of composite members – Flexural strength of composite members		

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi 2012.
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Company Private Limited, 2009.
3. Rajagopalan, N, "Prestressed Concrete", Alpha Science, 2010.

REFERENCES

1. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990 .
2. Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay 2010.
3. David A.Sheppard, William R. and Philips, Plant Cast precast and prestressed concrete - A design guide, McGraw Hill, New Delhi 1992.

15CE13E BASICS OF DYNAMICS AND ASEISMIC DESIGN L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Examine the response of linear and nonlinear SDOF system. (K4)
- CO2: Examine the response of linear and nonlinear MDOF system. (K4)
- CO3: Illustrate the fundamentals of seismology. (K2)
- CO4: Interpret the response of structures due to earthquake. (K2)
- CO5: Outline the methodology for aseismic design. (K6)

UNIT I SINGLE DEGREE OF FREEDOM SYSTEM 9

Degrees of freedom – SDOF idealization – Equations of motion of SDOF system – Free vibration of SDOF system – Response to harmonic excitation – Impulse and response to unit impulse – Duhamel integral.

UNIT II MULTIPLE DEGREE OF FREEDOM SYSTEM 9

Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion.

UNIT III ELEMENTS OF SEISMOLOGY 9

Causes of Earthquake –Mechanism –Formation- Basic definitions- Measuring instruments and scales- Information on some disastrous earthquakes.

UNIT IV RESPONSE OF STRUCTURES TO EARTHQUAKE 9

Concept of response and design spectra – Design earthquake – concept of peak acceleration – Site specific response spectrum –Effects of soil structure interaction– Liquefaction of soils – Importance of ductility – Methods of introducing ductility into RC structures.

UNIT V DESIGN METHODOLOGY 9

Codal provisions – Design as per the codes – Base isolation techniques – Vibration control measures –Effects of earthquake on structures.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Chopra, A.K., “Dynamics of Structures – Theory and Applications to Earthquake Engineering”, 2nd Edition, Pearson Education, 2015.
2. Pankaj Agarwal & Shrikhande, “Earth quake resistant Design of Structures”, PHI Learning, 2009.

Underground Construction –Under water Construction –Extreme weather concreting.

UNIT V SPECIAL CONCRETES 9

High Strength concrete – High Performance Concrete – Reactive powder concrete – Light weight concrete - Mass concrete – Self Compacting Concrete – Self curing Concrete – Polymer Concrete – Fibre Reinforced Concrete – Ready Mixed Concrete – Ferro cement – Shortcrete – Vacuum concrete.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Shetty M.S., “Concrete Technology”, S.Chand & Company, New Delhi, 2014.
2. Santhakumar. A.R, “Concrete Technology”, Oxford University Press, 2007.
3. Gambhir M.L., “Concrete Technology”, Tata Mc-Graw Hill Company, Noida, 2011.

REFERENCES

1. Orchard D.F., “Concrete Technology”, Vol I &II, 1998
2. Neville A.M., “Properties of Concrete”, Pearson Education, 2008

15CE15E DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C 3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Analyse the composite section (K3)
- CO2: Design Composite Beams (K6)
- CO3: Design Composite floors (K6)
- CO4: Design Composite Columns (K6)
- CO5: Design Composite Trusses (K6)

UNIT I INTRODUCTION TO STEEL CONCRETE COMPOSITE STRUCTURES 9

Modular ratio – Transformed section – Composite action – No interaction - Full interaction – Slip calculation -Stress block – Ultimate moment capacity. Provisions of IS: 11384 and Euro Code-4-2004.

UNIT II COMPOSITE BEAMS 9

Introduction to Composite beams - Ultimate moment behaviour – Types and load transferring mechanism of Shear connectors - Types, merits and behaviour of profiled decking - Design consideration for simply supported and continuous composite beam (with or without profile deck) - Problems.

UNIT III COMPOSITE FLOORS 9

Introduction of composite floors - Discuss on shear transferring mechanism in profile deck system - Bending resistance of composite slab - Design consideration of composite floor - Design of Composite floor.

UNIT IV COMPOSITE COLUMNS 9

Introduction to composite columns and its applications - Resistance of encased composite column cross section and infilled composite column cross section under compression - Design consideration of both encased and infilled composite column under - axial compression, uniaxial bending and biaxial bending – Problems.

UNIT V COMPOSITE TRUSSES 9

Behaviour and application of composite truss - Design consideration – stud specifications – Load calculation - Design of composite truss.

L:45; TOTAL: 45PERIODS

TEXT BOOKS

1. Johnson R.P (1994), “Composite Structures of Steel and Concrete”, volume I, Black well scientific publication, U.K.2012.
2. Narayanan R, “Composite steel structures – Advances, design and construction”, Elsevier, Applied science, UK, 2006

REFERENCE

1. Handbooks of INSDAG (periodicals)

**15CE16E ADVANCED STEEL STRUCTURES L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Design Different kinds of structural steel connection (K6)
- CO2: Design complex roof trusses (K6)
- CO3: Design storage structures (K6)
- CO4: Design cold formed steel beams (K6)
- CO5: Design cold formed steel columns (K6)

UNIT I	INTRODUCTION TO BEAM COLUMN JOINTS	9
	Beam to beam connection – Beam to column connection – Flexible, Rigid, Semi rigid connection- Shear and Moment Connection	
UNIT II	ROOF TRUSSES	9
	Load Calculation – Introduction to Tubular trusses – Design of Tubular trusses- Design of Fink and complex space trusses	
UNIT III	STORAGE STRUCTURES	9
	Design of Silo – Design of Bunker- Airy and Jansen’s theory	
UNIT IV	COLD FORMED STEEL BEAMS	9
	Introduction – Press brake and cold rolling Methods- I801 procedure – flat width ratio – Types of cross sections – local buckling and lateral buckling - Design of flexural member	
UNIT V	COLD FORMED STEEL COLUMNS	9
	Introduction – Q factor – Column design using IS 801 Procedure – Introduction to Direct Design method- Design of axially compressed column	

L:45; TOTAL : 45 PERIODS

TEXT BOOK

1. Teaching resource for, “Structural Steel Design,” Volume 1, 2 & 3, Institute for Steel Development and Growth (INSDAG), 2002.

REFERENCES

1. Trahair N S, Brandford M A, NethercotD,m Gardner L, “The Behaviour and Design of Steel Structures EC3”, 4th , Taylor& Francis, London & Newyork, 2008.
2. Englekirk R, “Steel Structures: Controlling Behaviour through Design”, John-Wiley & Sons, Inc, 2003.
3. Dayaratnam.P, “Design of Steel Structures”, A.H.Wheeler, India, 2007.
4. Linton E. Grinter, “Design of Modern Steel Structures”, Eurasia Publishing House, New Delhi, 1996.

UNIT III PHOTO ELASTICITY 9

Two dimensional photo elasticity – Stress optic law – Polariscopes – isoclinic and isochromatic fringes – compensators – Separation techniques – Model materials – Calibration of photo elastic materials.

UNIT IV MODEL ANALYSIS 9

Model analysis – Direct and Indirect models – laws of structural similitude – choice of scales – Model materials – Limitations of model studies – Buckingham pi theorem – Design of direct and indirect models – Begg's Deformeter and its applications.

UNIT V ADVANCED TECHNIQUES 9

Fundamentals of photo elastic coatings – Morie fringe and Brittle coating technique – crack detection techniques – Introduction to stress freezing technique. – Introduction to nondestructive testings – Holography

L 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Dally and Railey, "Experimental stress analysis", 2003.
2. Richard G Budynas, "Advanced Strength and Applied Stress Analysis", Tata McGraw Hill Publishing company Ltd., New Delhi, 2011

REFERENCES

1. Sadhu Singh, "Experimental stress analysis", Khanna Publishers, New Delhi, 2005.
2. Dove and Adam, "Experimental stress analysis and Motion measurements", 1989

**15CE19E NON DESTRUCTIVE TESTING L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

- CO1: Differentiate the Non destructive testing from destructive testing techniques. (K2)
- CO2: Explain the fundamentals and principles involved in the various Non destructive testing. (K2)
- CO3: Describe the procedures used to perform basic NDT techniques. (K2)
- CO4: Analyze the advantages and limitations of one method over other methods. (K2)

CO5: Critically appraise the NDT techniques available and select the most appropriate one for a given situation/application. (K2)

UNIT I VISUAL INSPECTION AND LIQUID PENETRANT TESTING 9

Introduction: Comparison of Destructive and Non-Destructive Tests - Conditions for Effective Non-Destructive Testing

Visual Inspection:-Optical aids used for visual Inspection - Applications

Liquid Penetrant Testing: Physical Principles - Procedure for Penetrant Testing - Penetrant Testing Materials – Penetrant Testing Methods - Water washable and Post - Emulsifiable Method.

UNIT II ULTRASONIC AND ACOUSTIC EMISSION TESTING 9

Ultrasonic Testing: Principle - Ultrasonic Transducers - Flaw detection equipment-Modes of display-Variables affecting Ultrasonic Test-Pulse echo, through transmission and Angle Beam Testing-Applications, Advantages and Limitations. Acoustic Emission Testing: Principle – Instrumentation – Advantages, Limitations and applications - Acoustic Emission testing of metal pressure vessels - Fatigue crack detection in Aerospace structures.

UNIT III MAGNETIC PARTICLE, EDDY CURRENT AND MAGNETIC FLUX LEAKAGE TESTING 9

Magnetic Particle Testing: Principle- magnetizing techniques- Procedure used for testing a component – Advantages, Limitations and applications

Eddy current Testing: Principles – Instrumentation for Eddy current testing – Inspection offerromagnetic materials - Pulsed eddy current testing-Applications.

Magnetic Flux Leakage (MFL) Testing: Principle-Magnetizing and Demagnetizing methods – MFL sensors – Flaw detection and analysis in ferromagnetic specimen – advantages, Limitations and applications.

UNIT IV THERMOGRAPHY AND RADIOGRAPHY TESTING 9

Thermography: Principle - Detectors and Equipments for active therrmography – heating sources – applications - Thermal imaging for condition monitoring of Industrial Components

Radiography: Principle - Electromagnetic radiation sources – Radiographic imaging equipments various inspection techniques - Reading and interpretation of radiographs – safety in industrial radiography.

UNIT V INDUSTRIAL APPLICATIONS OF NON-DESTRUCTIVE TESTING 9

Industrial Applications of Non Destructive Testing: Railways- Nuclear industry – Concrete structures - aircraft and aerospace industries – automotive industries - Selection of NDT methods – Codes, standards, specifications and Procedures.

L: 45; TOTAL : 45 PERIODS

TEXT BOOK

1. Baldev Raj, Jeyakumar, T., Thavasimuthu, M., “Practical Non Destructive Testing”, Narosa Publishing House, New Delhi, 2014.

REFERENCES

1. Charles J. Hellier, “Hand Book of Non-Destructive Evaluation”, The McGraw-Hill Companies, New York, 2012.
2. Christiane Maierhofer, Hans-Wolf Reinhardt and Gerd Dobmann, “Non-destructive evaluation of reinforced concrete structures”, Volume 2, CRC Press, New York, 2010.
3. Prasad J and C.G.K. Nair, “Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
4. V.M. Malhotra and N.J. Carino, "Handbook On Nondestructive Testing on Concrete", Second Edition, CRC Press, New York, 2004.
5. Peter J. Shull “Non Destructive Evaluation: Theory, Techniques and Application”, Marcel Dekker, Inc., New York, 2002.

15CE26E

ROCK ENGINEERING

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

- CO1: Classify the rock based on Index properties (K2)
- CO2: Explain the stress strain behavior in rocks (K2)
- CO3: Explain the insitu stresses and their measurements in rocks (K2)
- CO4: Apply the mechanism of rocks in construction (K3)
- CO5: Explain the in rock masses (K2)

UNIT I CLASSIFICATION AND INDEX PROPERTIES OF ROCKS 9

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose.

- CO2: Demonstrate the various dewatering and drainage systems (K2)
CO3: Summaries various insitu treatment of cohesionless and cohesive soils (K2)
CO4: Explain the concept of reinforcement in ground improvement (K5)
CO5: Explain soil stabilization with grouting techniques (K5)

UNIT I INTRODUCTION 9

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

UNIT II WAVES AND WAVE PROPAGATION 9

Drainage techniques - Well points - Vacuum and electro osmotic methods - Seepage analysis for two dimensional flow-fully and partially penetrating slots in homogenous deposits (Simple cases only).

UNIT III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 9

Insitu densification of cohesionless and consolidation of cohesive soils - Dynamic compaction and consolidation - Vibrofloatation - Sand pile compaction - Preloading with sand drains and fabric drains – Stone columns – Lime piles - Installation techniques only - relative merits of various methods and their limitations.

UNIT IV EARTH REINFORCEMENT 9

Concept of reinforcement - Types of reinforcement material - Applications of reinforced earth – use of Geotextiles for filtration, drainage and separation in road and other works.

UNIT V GROUT TECHNIQUES 9

Types of grouts – Grouting equipment and machinery – Injection methods – Grout monitoring – Stabilisation with cement, lime and chemicals – Stabilisation of expansive soils.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Koerner R.M., “Construction and Geotechnical Methods in Foundation Engineering”, McGraw-Hill, 1994.
2. Purushothama Raj, P. “Ground Improvement Techniques”, Tata McGraw-Hill Publishing Company, New Delhi, 1995

UNIT II GROUND MOTION CHARACTERISTICS 9

Strong Motion Records – Characteristics of ground motion – Factors influencing ground motion – Estimation of frequency content parameters – Seismic site investigations – Evaluation of Dynamic soil properties.

UNIT III GROUND RESPONSE ANALYSIS AND GROUND MOTION 9

Wave propagation Analysis – Site Amplification – Need for Ground Response Analysis – Shear Beam analysis – Methods of analyses – One Dimensional Analysis – Equivalent linear Analysis - Site effects – Design Ground Motion – Developing Design Ground Motion – Codal provisions

UNIT IV SEISMIC STABILITY ANALYSIS 9

Earthquake – Resistant Design of foundation of buildings – Design considerations – Geotechnical – Architectural – Structures – Capacity Design – Seismic analysis. Dynamic Analysis – Earth pressure due to ground shaking - Liquefaction–Susceptibility – evaluation – Cyclic stress approach – Liquefaction Resistance – Laboratory and Field Tests – Interpretation– Lateral Deformation – Codal recommendation.

UNIT V EARTHQUAKE HAZARD MITIGATION 9

Seismic risk vulnerability and hazard – Percept of risk – Risk mapping – Hazard assessment – Maintenance and modifications to improve hazard resistance – Different type of foundation and its impact on safety – Ground Improvement Techniques.

L :45; TOTAL: 45 PERIODS

TEXT BOOKS

1. KameswaraRao, N.S.V., “Dynamics soil tests and applications”, Wheeler Publishing – New Delhi, 2000.
2. Krammer S.L., “Geotechnical Earthquake Engineering”, Prentice Hall, International series Pearson Education (Singapore) Pvt. Ltd., 2004.

REFERENCES

1. McGuire, R.K., “Seismic Hazard and Risk Analysis”, Earthquake Engineering Research Institute, MNo – 10, ISBN 0-943198-01-1, 2004.
2. Mahanti, N.C., Samal, S.K., Datta, P., Nag N.K., “Disaster Management”, Narosa Publishing House, New Delhi, India ISBN : 81-7319-727X-2006

15CE36E REMOTE SENSING TECHNIQUES AND L T P C
GEOGRAPHIC INFORMATION SYSTEM 3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain the basic concepts of remote sensing (K2)
- CO2: Classify the types of platform and sensors (K2)
- CO3: Interpret about image interpretation and analysis (K2)
- CO4: Apply GIS in civil Engineering field (K3)
- CO5: Interpret the data entry, storage and analysis (K2)

UNIT I EMR AND ITS INTERACTION WITH ATMOSPHERE 9

Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Atmospheric scattering– Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.

UNIT II PLATFORMS AND SENSORS 9

Types of platforms — Passive and Active sensors– resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and space borne TIR and microwave sensors.

UNIT III IMAGE INTERPRETATION AND ANALYSIS 9

Types of Data Products – Image interpretation - visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised.

UNIT IV GEOGRAPHIC INFORMATION SYSTEM 9

Introduction – Maps – Map projections– map analysis – GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS).

UNIT V DATA ENTRY, STORAGE AND ANALYSIS 9

Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

L :45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas Lillesand, Ralph W.Kiefer,JonathanChipman,“Remote Sensing and Image Interpretation”,January 2015
2. Anji Reddy, M., “Remote Sensing and Geographical Information System”, BS Publications, Hyderabad, 2005.

REFERENCES

1. Lo. C.P. and A.K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India Private Limited, New Delhi, Pp: 492., 2002.
2. Peter A.Burrough, Rachael A.McDonnell, “Principles of GIS”, Oxford University Press, 2000.

15CE37E

PAVEMENT ENGINEERING

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Identify the type of pavement and distribution of stress (K3)
- CO2: Design the flexible pavement (K6)
- CO3: Design the rigid pavement (K6)
- CO4: Apply type of maintenance and evaluation procedure of the pavement (K3)
- CO5: Identify different methods for stabilization of pavement (K3)

UNIT I GENERAL PRINCIPLES OF PAVEMENT DESIGN 9

Introduction - Pavement as layered structure - Pavement types – Pavement stability - Stress and deflections in pavements under repeated loading

UNIT II DESIGN OF FLEXIBLE PAVEMENT 9

Empirical – Semi empirical and theoretical Methods – Design procedure as per latest IRC guidelines - Design and specification of rural road

UNIT III DESIGN OF RIGID PAVEMENT 9

Cement concrete pavements - Modified Westergard approach - Design procedure as per latest IRC guidelines - Joints in rigid pavements - Concrete roads and their scope in India.

UNIT IV PERFORMANCE EVALUATION AND MAINTENANCE 9

Pavement Evaluation [Condition and evaluation surveys] - Structural Evaluation by Deflection Measurements, Present Serviceability Index] –

Strengthening of Pavement - Pavement maintenance. [IRC Recommendations Only]

UNIT V STABILISATION OF PAVEMENTS 9

Stabilisation with special reference to highway pavements - Choice of stabilisers -Testing and field control – Stabilisation for rural roads in India - Geosynthetics (geotextiles &geogrids) in roads.

L: 45; TOTAL: 45PERIODS

TEXT BOOKS

1. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna tech. Publications, New Delhi, 2005.
2. Khanna K and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 10th Edition 2010.
3. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001

REFERENCES

1. Yoder R.J and Witczak M.W., "Principles of Pavement Design", John Wiley, 1975.
2. Guidelines for the Design of Flexible Pavements, IRC: 37 - 2001, The Indian roads Congress, New Delhi.
3. Guideline for the Design of Rigid Pavements for Highways, IRC: 58-2002, the Indian Roads Congress, New Delhi.

**15CE38E TRAFFIC ENGINEERING AND MANAGEMENT L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1 : Explain the fundamental characteristics of road, traffic and land use (K2)
- CO 2 : Apply appropriate techniques of traffic surveys and analysis (K3)
- CO 3 : Design various methods of traffic control measures (K6)
- CO 4 : Design elements of traffic intersections (K6)
- CO 5 : Summarize various methods of traffic management (K2)

UNIT I INTRODUCTION 9

Significance and scope - characteristics of vehicles and road users - skid resistance and braking efficiency –components of traffic engineering-road,

traffic and land use characteristics -Storm water collection-Street inlets-
Urban drainage

UNIT II TRAFFIC SURVEYS AND ANALYSIS 9

Basic principles of traffic flow - surveys and analysis - volume, capacity, speed and delays, origin and destination, parking, pedestrian studies, accident studies and safety- level of services, Street lighting by solar power

UNIT III TRAFFIC CONTROL 9

Traffic signs and road markings - design of traffic signals and signal co-ordination - traffic control aids and street furniture - street lighting by solar power- computer applications in signal design

UNIT IV GEOMETRIC DESIGN OF INTERSECTIONS 9

Conflicts at intersections - classification of 'at grade' intersections - channelized intersections - principles of intersection design - elements of intersection design - rotary design - grade separation and interchanges - design principles.

UNIT V TRAFFIC MANAGEMENT 9

Traffic management - transportation system management (TSM) - travel demand management (TDM) - traffic forecasting techniques - one way streets-traffic segregation - traffic calming - exclusive bus lanes - intelligent transportation system (ITS).

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Khanna K and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2014.
2. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2000.

REFERENCES

1. Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management
2. Guidelines of Ministry of Road Transport and Highways, Government of India.
3. Subhash C.Saxena, A Course in Traffic Planning and Design, Dhanpat Rai Publications, New Delhi, 1989.
4. Transportation Engineering – An Introduction, C.Jotin Khisty, B.Kent Lall, Prentice Hall of India Pvt Ltd, 2006.

15CE39E RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explain the components of railways, their functions and its geometric design (K2)
- CO2: Explain construction, maintenance and operation of railway track (K2)
- CO3: Illustrate the concepts of Airport planning and design (K2)
- CO4: Identify the airport layouts, visual aids and air traffic control (K3)
- CO5: Summarize various components of harbour, its function and layout (K2)

UNIT I RAILWAY PLANNING AND DESIGN 10

Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS - Engineering Surveys for Track Alignment – Obligatory points - Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other equipments) - Permanent Way, its Components and their Functions: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks -Sleepers – Functions, Materials, Density – Functions, Materials, Ballastless Tracks - Geometric Design of Railway Tracks – Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.

UNIT II RAILWAY TRACK CONSTRUCTION, MAINTENANCE AND OPERATION 8

Design of Turnouts, Working Principle - Signalling, Interlocking and Track Circuiting - Construction & Maintenance – Track Drainage - Track Modernisation– Automated maintenance and upgrading, Re-laying of Track, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.

UNIT III AIRPORT PLANNING AND DESIGN 10

Role of Air Transport, Components of Airports - Airport Planning – Air traffic potential, Site Selection, Design of Components, Cost Estimates, Evaluation and Institutional arrangements Runway Design- Orientation, Cross wind Component, Wind rose Diagram (Problems), Geometric Design and Corrections for Gradients (Problems), Drainage - Taxiway Design – Geometric Design Elements, Minimum Separation Distances, Design Speed, Airport Drainage - Airport Zoning - Clear Zone, Approach Zone, Buffer Zone, Turning Zone, Clearance over Highways and Railways

UNIT IV AIRPORT LAYOUTS, VISUAL AIDS, AND AIR TRAFFIC CONTROL 7

Airport Layouts – Apron, Terminal Building, Hangars, Motor Vehicle Parking Area and Circulation Pattern, Case studies of Airport Layouts - Airport Buildings – Primary functions, Planning Concept, Principles of Passenger Flow, Passenger Facilities - Visual Aids – Runway and Taxiway Markings, Wind Direction Indicators, Runway and Taxiway Lightings - Air Traffic Control – Basic Actions, Air Traffic Control Network - Helipads, Hangars, Service Equipments.

UNIT V HARBOUR ENGINEERING 10

Natural phenomena of harbour - Requirements and Classification of Harbour – Ports and its classification – Layout of harbour -Site Selection & Selection Investigation – Dry and Wet Docks, Planning and Layouts – Port Buildings, Warehouse, Transit Sheds, Inter-modal Transfer Facilities, Mooring Accessories, Navigational Aids-Coastal Structures - Coastal Shipping, Inland Water Transport and Container Transportation.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Saxena Subhash C and Satyapal Arora, A Course in Railway Engineering, Dhanpat Rai and Sons, Delhi, 2010.
2. Khanna S K, Arora M G and Jain S S, Airport Planning and Design, Nemchand and Brothers, Roorkee, 1994.

REFERENCES

1. Rangwala, Railway Engineering, Charotar Publishing House, 2012.
2. Rangwala, Airport Engineering, Charotar Publishing House, 1996.
3. Oza.H.P. and Oza.G.H., “A course in Docks & Harbour Engineering”. Charotar Publishing Co.1976.
4. J.S. Mundrey, “A course in Railway Track Engineering”. Tata McGraw Hill, 2000.

**15CE46E ENVIRONMENTAL IMPACT ASSESSMENT L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Identify the impact on environment in civil engineering projects (K3)
- CO2: Apply the knowledge in legal and regulatory aspect in India according to MoEF (K3)
- CO3: Explain the methodologies, prediction and assessment (K2)

CO4: Select and prepare environmental management plan for civil engineering projects (K2)

CO5: Select and prepare EIA report for a development project (K3)

UNIT I INTRODUCTION 8

Impact of development projects under Civil Engineering on environment - Environmental Impact Assessment (EIA) – EIA necessity and its limitations- Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA

UNIT II METHODOLOGIES 9

Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives

UNIT III PREDICTION AND ASSESSMENT 9

Assessment of Impact on land, water and air, noise, social, cultural flora and fauna; Mathematical models; public participation – Rapid EIA

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – ISO 14000

UNIT V CASE STUDIES 10

EIA for infrastructure projects – Bridges – Stadium – Highways – Dams – Multi-storey Buildings – Water Supply and Drainage Projects

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Canter, R.L., “Environmental Impact Assessment”, McGraw-Hill Inc., New Delhi, 1996.
2. Shukla, S.K. and Srivastava, P.R., “Concepts in Environmental Impact Analysis”, Common Wealth Publishers, New Delhi, 1992.

REFERENCES

1. John G. Rau and David C Hooten (Ed)., “Environmental Impact Analysis Handbook”, McGraw-Hill Book Company, 1990.
2. “Environmental Assessment Source book”, Vol. I, II & III, The World Bank, Washington, D.C., 1991.
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I & II”, Blackwell Science, 1999.

TEXT BOOKS

1. M.N.Rao & A.K.Dutta, "Wastewater Treatment", Oxford - IBH Publication, 1995.
2. W.W.Eckenfelder Jr., "Industrial Water Pollution Control", McGraw-Hill Book Company, New Delhi, 2000.

REFERENCES

1. T.T.Shen, "Industrial Pollution Prevention", Springer, 1999.
2. R.L.Stephenson and J.B.Blackburn, Jr., "Industrial Wastewater Systems Hand book", Lewis Publisher, New York, 1998
3. H.M.Freeman, "Industrial Pollution Prevention Hand Book", McGraw-Hill Inc., New Delhi, 1995.

15CE48E

AIR POLLUTION MANAGEMENT

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Summarize the sources and effects of air pollutants (K2)
- CO2: Explain the factors and models contributing the dispersion of air pollutants (K2)
- CO3: Explain the instruments and method used to control air pollution (K2)
- CO3: Identify the concepts and principles of air pollution and air quality management (K3)
- CO4: Outline the sources, effects and control measures of noise pollution (K2)

UNIT I SOURCES AND EFFECTS OF AIR POLLUTANTS 9

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution –Ambient Air Quality Standards – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.

UNIT II DISPERSION OF POLLUTANTS 9

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.

UNIT III AIR POLLUTION CONTROL 9

Concepts of control – Principles and design of control measures –

Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries (Cement, Smelter, Pulp & Paper and Thermal Power Plant).

UNIT III AIR QUALITY MANAGEMENT 9

Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality

UNIT V NOISE POLLUTION 9

Sources of noise pollution – Effects – Assessment - Standards – Control methods – Prevention

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Anjaneyulu, D., "Air Pollution and Control Technologies", Allied Publishers, Mumbai, 2002.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata-McGraw-Hill, New Delhi, 1996.

REFERENCES

1. W.L.Heumann, Industrial Air Pollution Control Systems, McGraw-Hill, New York, 1997.
2. Mahajan S.P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company, New Delhi, 1991.
3. Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, New Delhi, 1985.
4. Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi
5. Mahajan, S.P., "Pollution Control in Process Industries", Tata McGraw-Hill, New Delhi, 1991.

15CE49E MUNICIPAL SOLID WASTE MANAGEMENT

L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: Infer the waste generated by the community and its effects on environment (K2)
- CO 2: Outlines the collection methods, collection vehicles and man power requirement (K2)
- CO 3: Identify the optimum collection routes (K3)
- CO 4: Explain the details of processing of solid waste (K2)
- CO 5: Make use of different disposal methods (K3)

UNIT I SOURCES AND TYPES OF MUNICIPAL SOLID WASTES 9

Sources and types of solid wastes – Quantity – Factors affecting generation of solid wastes; characteristics – methods of sampling and characterization; Effects of improper disposal of solid wastes – Public health effects. Principle of solid waste management – Social & economic aspects Public awareness; Role of NGOs; Legislation. Source reduction – Reduction, Recycle, Reuse.

UNIT II ON-SITE STORAGE AND PROCESSING 9

On-site storage methods – Materials used for containers – On-site segregation of solid wastes public health & economic aspects of storage – Options under Indian conditions – Critical Evaluation of Options.

UNIT III COLLECTION AND TRANSFER 9

Methods of Collection – types of vehicles – Manpower requirement – Collection routes; transfer stations – Selection of location, operation & maintenance; options under Indian conditions-Field problems during transfer

UNIT IV OFF-SITE PROCESSING 9

Objectives of waste processing - Processing techniques and Equipment; Resource recovery from solid wastes – Composting, Incineration, Pyrolysis - options under Indian conditions.

UNIT V DISPOSAL 9

Dumping of solid waste; sanitary landfills – Site selection, design and operation of sanitary landfills – Leachate collection & treatment – Monitoring ambient air quality – Public health. Dumpsite rehabilitation

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. George Tchobanoglous et.al., "Integrated Solid Waste Management", McGraw-Hill Publishers, 1993.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994.

REFERENCES

1. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
2. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes – problems and Solutions", Lewis Publishers, 1997.
3. Bhide A.D. and Sundaresan, B.B., "Solid Waste Management in Developing Countries", INSDOC, 1993.

15CE50E

ECOLOGICAL ENGINEERING

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Explains the concept of ecosystem (K2)
- CO2: Infer the function of ecosystem and its biochemical reaction (K2)
- CO3: Make use of rehabilitation methods for the treatment of ecosystem (K3)
- CO4: Outline the effects due to industrialization and its case studies (K2)

UNIT I PRINCIPLES AND CONCEPTS 9

Scope and applications of Ecological Engineering – Development and evolution of ecosystems – Principles and concepts pertaining to species, populations and community

UNIT II ECOSYSTEM FUNCTIONS 9

Biological magnification, diversity and stability, immature and mature systems - Primary productivity – Biochemical cycling of nitrogen, phosphorous, sulphur and carbon dioxide – Habitat ecology - Terrestrial, fresh water, estuarine and marine habitats.

UNIT III ECOLOGICAL ENGINEERING METHODS 9

Bio monitoring and its role in evaluation of aquatic ecosystem; Rehabilitation of ecosystems through ecological principles – Step cropping, bio-wind screens, Wetlands, ponds, Root Zone Treatment for wastewater, Reuse of treated wastewater through ecological systems.

UNIT IV ECOLOGICAL EFFECTS OF INDUSTRIALISATION 9
Ecological effects of exploration, production, extraction, processing, manufacture & transport.

UNIT V CASE STUDIES 9
Case studies of integrated ecological engineering systems

L : 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Odum, E.P., "Fundamental of Ecology", W.B.Sauders, 1990.
2. Kormondy, E.J., "Concepts of Ecology", Prentice Hall, New Delhi, 1996

REFERENCES

1. Mitch, J.W. and Jorgensen, S.E., Ecological Engineering – An Introduction to Ecotechnology, John Wiley and Sons, 1996.
2. Colinvaux, P., Ecology, John Wiley and Sons, 1996.
3. Etnier, C & Guterstam, B., "Ecological Engineering for Wastewater Treatment", 2nd Edition, Lewis Publications, London, 1996.

15CE51E ENVIRONMENTAL INSTRUMENTATION L T P C
3 0 0 3

Upon completion of this course, the students will be able to

- CO1: Discuss the fundamental blocks of Measurement system (K2)
- CO2: Explain the working and list the types of sensor and transducer (K2)
- CO3: Explain the causes and effects of water, air and noise pollution on environment (K2)
- CO4: Describe the working principle of instruments for quality of water, air and sound monitoring and measurement (K2)
- CO5: Select the appropriate instrument for specific application (K2)
- CO6: List the manufacturers of instruments for environmental monitoring and measurement and control (K2)

UNIT I INTRODUCTION 9
Definition: Measurement and Instrumentation, Block diagram of Measurement system – Types of Sensor and Transducer. Necessity of instrumentation & control for environment, sensor requirement for environment.

UNIT II WATER 9

Definitions, causes and effects of water pollution. Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality measurement: Thermal conductivity detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application.

UNIT III GROUND AND WASTE WATER 9

Level measurement in wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution. Automatic waste water sampling, optimum waste water sampling locations. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Quality assurance of storage water.

UNIT IV AIR 9

Definitions, causes and effects of air pollution, air pollution from thermal power plant. Air sampling methods & equipments, analytical methods for air pollution studies. Measurement of ambient air quality. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement.

UNIT V SOUND 9

Definitions, causes and effects of Noise Pollution and Its Monitoring. Ambient noise, Noise intrusions, impulsive noise, transient noise, airport noise. Sound level meters. Tape recorders, noise dosimeters, sound level monitors and acoustical calibrators. Field equipments for noise measurement.

L 45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Measurement Systems 6th Edition, E.O.Doebelin, Dhanesh N Manik, TMcGH, 2011
2. Environmental Instrumentation and Analysis Handbook, Randy D Down, Jay H Lehr, John Wiley & Sons, 2005.
3. Instrumentation for Studying Vegetation Canopies for Remote Sensing in Optical and Thermal Infrared Regions, Narendra S. Goel, John M. Norman, Taylor & Francis, 1990.

REFERENCES

1. A course manual: Instrumentation in Environmental Engg. NEERI Publications.Nagpur.
2. Handbook of Analytical Instruments, 2nd Edition, R.S. Khandpur, TMcGH, 2007

15CE61E

HYDROLOGY

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Estimate the hydrological cycle and rainfall over a region (K2)

CO2: Relate the process of precipitation and evaporation and its measurements (K2)

CO3: Analyse the concept of hydrographs (K3)

CO4: Explain the measures of flood control and flood routing (K3)

CO5: Explain the knowledge about the types of aquifer (K3)

UNIT I INTRODUCTION ABOUT PRECIPITATION 9

Hydrologic cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of point rainfall – Intensity, duration, frequency relationship – Probable maximum precipitation. Weather and hydrology – General circulation Temperature humidity – Wind – Diurnal and monsonic wind systems.

UNIT II ABSTRACTION FROM PRECIPITATION AND EVAPORATION 9

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall - Infiltration factors affecting evaporation – Measurement of evaporation

UNIT III HYDROGRAPHS 9

Factors affecting Hydrograph – Base flow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different deviations - Synthetic Unit Hydrograph

UNIT IV FLOODS AND FLOOD ROUTING 9

Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir flood routing – Muskingum's Channel Routing – Flood control – Storm

UNIT V GROUND WATER HYDROLOGY 9

Types of aquifers – Darcy's law – Dupuit's assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test – Transmissibility – Specific capacity – Pumping test – Steady flow analysis only.

L :45; TOTAL: 45 PERIODS

UNIT III WAVE FORECASTING AND TIDES 9

Need for forecasting - SMB and PNJ methods of wave forecasting – Classification of tides – Darwin’s equilibrium theory of tides – Effects on structures – Seiches – Surges and Tsunamis.

UNIT IV COASTAL PROCESSES 8

Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.

UNIT V HARBOURS 9

Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore forest.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Richard Sylvester, “Coastal Engineering, Volume I and II”, Elseiner Scientific Publishing Co., 1999
2. Quinn, A.D., “Design & Construction of Ports and Marine Structures”, McGraw-Hill Book Co., 1999

REFERENCES

1. Ed. A.T. Ippen, “Coastline Hydrodynamics”, McGraw-Hill Inc., New York, 1993
2. Dwivedi, S.N., Natarajan, R and Ramachandran, S., “Coastal Zone Management in Tamilnadu”.

**15CE64E WATER RESOURCES ENGINEERING L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Outline the water resource planning and water policy (K3)
- CO2: Generalize the station network design. (K3)
- CO3: Infer on water resource needs. (K3)
- CO4: Discuss on reservoir planning and management (K3)
- CO5: Explain on economic analysis (K3)

UNIT I GENERAL 9

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Economics of water resources

planning, physical and socio economic data – National Water Policy – Collection of meteorological and hydrological data for water resources development.

UNIT II NETWORK DESIGN 9

Hydrologic measurements – Analysis of hydrologic data – Hydrologic station network – Station network design – Statistical techniques in network design.

UNIT III WATER RESOURCE NEEDS 9

Consumptive and non-consumptive water use - Estimation of water requirements for irrigation, for drinking and navigation - Water characteristics and quality – Scope and aims of master plan - Concept of basin as a unit for development - Water budget and development plan.

UNIT IV RESERVOIR PLANNING AND MANAGEMENT 9

Reservoir - Single and multipurpose – Multi objective - Fixation of Storage capacity -Strategies for reservoir operation - Sedimentation of reservoirs - Design flood-levees and flood walls - Channel improvement.

UNIT V ECONOMIC ANALYSIS 9

Estimation of cost and Evaluation of Benefits - Discount rate - Discounting factors - Discounting techniques – Computer Applications.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Linsley R.K. and Franzini J.B, “Water Resources Engineering”, McGraw-Hill Inc, 2000.
2. Douglas J.L. and Lee R.R., “Economics of Water Resources Planning”, Tata McGraw-Hill Inc. 2000.
3. Duggal, K.N. and Soni, J.P., “Elements of Water Resources Engineering”, New Age International Publishers 1998

REFERENCES

1. Chaturvedi M.C., “Water Resources Systems Planning and Management”, Tata McGraw-Hill Inc., New Delhi, 1997.
2. Goodman Alvin S., “Principles of Water Resources Planning”, Prentice-Hall, 1984.

15CE71E HOUSING PLANNING AND MANAGEMENT L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Outline the basics involved in housing planning (K2)
- CO2: Explain the various programs involved in housing (K2)
- CO3: Design a housing project (K6)
- CO4: Summarize the construction techniques and cost effective materials (K2)
- CO5: Discuss on housing finance and project appraisal (K2)

UNIT I INTRODUCTION TO HOUSING 9

Definition of Basic terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES 9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS 9

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST- EFFECTIVE MATERIALS 9

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL 9

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern.

L : 45; TOTAL: 45 PERIODS

Characteristics of climate types – Design for various climate types –
Passive and active energy controls – Green building concept

UNIT V TOWN PLANNING 8

Planning – Definition, concepts and processes - Urban planning standards
and zoning regulations - Urban renewal – Conservation – Principles of
Landscape design

L :45; TOTAL : 45 PERIODS

TEXT BOOKS

1. Francis D.K. Ching, "Architecture: Form, Space and Order", VNR,
New York, 1999.
2. Givoni B., "Man Climate and Architecture", Applied Science, Barking
ESSEX, 1982
3. Edward D.Mills, "Planning and Architects Handbook", Butterworth
London, 1995.

REFERENCES

1. Gallian B.Arthur and Simon Eisner, "The Urban Pattern – City
Planning and Design", Affiliated Press Private Limited, New Delhi,
1995.
2. Margaret Robert, "An Introduction to Town Planning Techniques",
Hutchinso London, 1990.

**15CE73E TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Recognize the need for total quality management and areas of
application of this Management concept (K2)
- CO2: Predict the need for customer expectations and employee
involvement. (K2)
- CO3: Estimate six – sigma and perform benchmarking. (K4)
- CO4: Devise methods to use Quality Fuction Devolpment (QFD), failure
Mode Effect Analysis (FMEA) and Taguchi's loss functions. (K2)
- CO5: Describe ISO 9000 and Environmental Management System
(EMS) standards. (K2)

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality -
Dimensions of manufacturing and service quality - Basic concepts of TQM

- Definition of TQM —Contributions of Deming, Juran and Crosby – Cost of Quality, Analysis Techniques for Quality Costs -Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, - Business Excellence Model-Rajiv Gandhi National Quality Award

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking– Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing - QS9000 – ISO14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Dale H.Besterfield, et al., “Total Quality Management”, Pearson Education Asia, 3rd Edition, Indian Reprint 2010.
2. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western Thomson Learning, 2005.

REFERENCE

1. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

15CE74E ENGINEERING ECONOMICS AND COST ANALYSIS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

- CO1: Explain the basics of economics (K2)
- CO2: Compare Demand and Schedule (K2)
- CO3: Explain the basic terms in organization (K2)
- CO4: Explain the basic terms in Financing (K2)
- CO5: Explain the basic terms in Analysis of cost (K5)

UNIT I BASIC ECONOMICS 9

Definition of economics - Nature and scope of economic science - Nature and scope of managerial economics - Basic terms and concepts - Goods - Economies of large and small scale - Consumption -Wants characteristics and classification - Law of diminishing marginal utility - relation between economic decision and technical decision

UNIT II DEMAND AND SCHEDULE 9

Demand - Demand schedule - Demand curve - Law of demand - Elasticity of demand - Types of elasticity - Factors determining elasticity - Measurement - Its significance - Supply - Supply schedule - Supply curve - Law of supply - Elasticity of supply - Time element in the determination of value - Market price and normal price - Perfect competition - Monopoly - Monopolistic competition.

UNIT III ORGANISATION 9

Forms of business - Proprietorship - Partnership - Joint stock company - Cooperative organisation - State enterprise - Mixed economy - Money and banking - Banking - Kinds - Commercial banks -Central banking functions - Control of credit - Monetary policy - Credit instrument.

UNIT IV FINANCING 9

Types of financing - Short term borrowing - Long term borrowing - Internal generation of funds -External commercial borrowings - Assistance from government budgeting support and international finance corporations - analysis of financial statement – Balance Sheet - Profit and Loss account - Funds flow statement.

UNIT V COST AND BREAK EVEN ANALYSES 9

Types of costing – Traditional costing approach - Activity base costing - Fixed Cost – Variable cost – Marginal cost – Cost Output Relationship In The Short Run And In Long Run – Pricing Practice – Full Cost Pricing –

Open Elective Course (OEC)
Group - I (Inter-disciplinary courses)

15ID01E	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
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COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: analyze various global trends and identify the scope of a new product (K4)
- CO2: perform requirement analysis and convert the requirements into design specification (K4)
- CO3: translate conceptual idea into detailed design (K6)
- CO4: create prototype to demonstrate the product (K6)
- CO5: perform sustenance engineering to improve the longevity of the product(K6)

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends-Technical Trends- Economical Trends- Environmental Trends- Political/ Policy Trends- PESTLE Analysis.

Introduction to Product Development Methodologies and Management: Overview of Products and Services- Types of Product Development- Overview of Product Development methodologies - Product Life Cycle and PLM - Product Development Planning and Management .

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering: Types of Requirements- Requirement Engineering- Analysis -Traceability Matrix and Analysis- Requirement Management

System Design and Modeling: Introduction to System Modeling- Introduction to System Optimization- System Specification-Sub-System Design- Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - Concept Screening and Evaluation - Concept Design - S/W Architecture - Hardware Schematics and simulation

Detailed Design: Component Design and Verification - High Level Design/Low Level Design of S/W Programs - S/W Testing-Hardware Schematic - Component design - Layout and Hardware Testing.

UNIT IV IMPLEMENTATION AND INTEGRATION 9

Prototyping: Types of Prototypes -Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration- Testing- Certification and Documentation: Introduction to Manufacturing/Purchase and Assembly of Systems- Integration of Mechanical, Embedded and S/W systems- Introduction to Product verification and validation processes - Product Testing standards, Certification and Documentation.

UNIT V SUSTENANCE ENGINEERING AND BUSINESS DYNAMICS 9

Sustenance - Maintenance and Repair - Enhancements

Product End of Life (EoL): Obsolescence Management-Configuration Management - EoL Disposal.

The Industry - Engineering Services Industry overview - Product development in Industry versus Academia

The IPD Essentials - Introduction to vertical specific product development processes - Product development Trade-offs - Intellectual Property Rights and Confidentiality- Security and configuration management

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10-007-14679-9.
2. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9

REFERENCES

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education, ISBN 9788177588217
2. Yousef Haik, Shahin T M M, "Engineering Design Process", Cengage Learning,2nd Edition Reprint, 2010, ISBN 0495668141
3. Clive L Dym, Patrick Little, "Engineering Design: A Project-based Introduction", John Wiley & Sons, 3rd Edition, 2009, ISBN 978-0-470-22596-7
4. Kevin Otto & Kristin Wood, "Product Design Techniques in Reverse Engineering and New Product Development", Pearson Education (LPE), 2001.
5. James R Evens, William M Lindsay "The Management and control of Quality" Pub:son south-western(www.swlearning.com), 6th edition.
6. AmitavaMitra, "Fundamentals of Quality control and improvement" Pearson Education Asia, 2nd edition, 2002.

UNIT IV DISASTER MANAGEMENT 9

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue ,relief And Rehabilitation, Role Of National And International Agencies In Disaster Management-National Disaster Policy Of India (Salient Features).

UNIT V APPLICATIONS OF SCIENCE AND TECHNOLOGY AND CASE STUDIES 8

Applications of Science and Technology (RS, GIS, GPS) - Early Warning And Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies

L: 45; TOTAL: 45 PERIODS

TEXTBOOKS

1. S.K.Singh, S.C. Kundu, Shobha Singh A ,”Disaster management”, William Publications, New Delhi, 1997.
2. Vinod K Sharma, “Disaster Management”, IIPA, New Delhi, 1995

REFERENCE

1. Annual Report, 2009-10,Ministry of Home Affairs, GOI

15ID03E	ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the operation of Solar Thermal application and Solar Photovoltaic. (K2)
- CO2: explain the operation of wind energy systems. (K2)
- CO3: describe the concepts of various Bio-Energy Conversion techniques. (K2)
- CO4: illustrate the concepts of other conventional and nonconventional power plants. (K2)
- CO5: explain the concepts of hydrogen and fuel cell technology. (K2)

UNIT I INTRODUCTION TO SOLAR ENERGY 9

Sun - Earth Geometry, solar radiation, Solar Collectors - Application of solar thermal systems. Direct Electricity Conversion - Types of Solar cell - Solar Photovoltaic system and types.

UNIT II WIND ENERGY 9

Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

UNIT III BIO-ENERGY 9

Biomass: sources, characterization, principles of energy transfer technologies.
Biogas: Feedstock, types of Biogas plant- parameters affecting biogas production.

UNIT IV OTHER POWER PLANTS 9

Layout of Hydel - thermal - Nuclear - Gas turbine - Diesel - MHD- Geo thermal - OTEC -Tidal Power Plants.

UNIT V HYDROGEN AND FUEL CELLS 9

Energy carrier: Types - Hydrogen: generation, storage, transport and utilization - thermal energy storage: Principle and utilization - Fuel cells: Technologies, types and applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Soteris Kalogirou, "Solar Energy Engineering: Processes and Systems", Academic Press, 2014.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K, 3rd Edition, 2012.

REFERENCES

1. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 2nd Edition, 2006.
2. Hart A B and Womack, G J, "Fuel Cells: Theory & Applications", Prentice Hall, 1997.
3. El-Wakil M M, "Power Plant Technology", Tata McGraw-Hill, 2010.
4. Khandelwal K C and Mahdi S S, "Biogas Technology" - A Practical Handbook, Tata McGraw Hill, 1986.
5. Duffie J A and Beckman W A, "Solar Engineering of Thermal Processes", Wiley, 4th Edition, 2013.
6. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", Prentice Hall of India, 3rd Edition, 2015.

Group - II (Trans disciplinary courses)

15TD01E

INDIAN BUSINESS LAWS

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the elements of a valid contract.
- CO 2: discuss main provisions relating to Sale of Goods Act and Negotiable Instruments Act.
- CO 3: explain provisions relating to incorporation and functioning of company and partnership firm.
- CO 4: understand the fundamentals of Consumer Protection Act and Foreign Exchange Management Act.
- CO 5: understand the basic knowledge of Information Technology Act and RTI Act.

UNIT I THE INDIAN CONTRACT ACT, 1872

Definition of a Contract and its essentials - Formation of a valid Contract - Offer and Acceptance, Consideration - Capacity to Contract - Free consent - Legality of object - Discharge of a Contract by performance - Impossibility and Frustration - Breach, Damages for breach of a contract - Quasi contracts - Special Contracts - Contract of Indemnity and Guarantee - Contract of Bailment and Pledge - Contract of Agency.

UNIT II THE SALE OF GOODS ACT, 1930

Definition of a Contract of Sale - Conditions and Warranties - Passing of Property - Right of Unpaid Seller against the Goods - Remedies for Breach - The Negotiable Instrument Act, 1881
Definition and characteristics - Kinds of negotiable instruments - Promissory Note - Bill of Exchange and Cheques - Holder and Holder in due course - Negotiation, Presentment, Discharge from Liability - Noting and Protest - Presumption - Crossing of Cheques - Bouncing of Cheques.

UNIT III THE COMPANIES ACT, 1956

Nature and Definition of a Company - Registration and Incorporation - Memorandum of Association - Articles of Association - Prospectus - Kinds of Companies - Directors: Their powers and duties - Meetings - Winding up - The Indian Partnership Act, 1932 - Definition of Partnership and its essentials - Rights and Duties of Partners: Types of Partners - Minor as a partner - Doctrine of Implied Authority - Registration of Firms - Dissolution of firms - Limited Liability Partnership Act, 2000.

UNIT IV THE CONSUMER PROTECTION ACT, 1986

Aims and Objects of the Act - Redressal Machinery and Procedure for complaints under the Act - Remedies - Appeals - Enforcement of orders and Penalties - Foreign Exchange Management Act 2000 - Definition and Main Provisions.

UNIT V THE INFORMATION TECHNOLOGY ACT

Definition, Digital Signature - Electronic Governance – Attribution - Acknowledgment and Dispatch of Electronic Records - Sense Electronic Records and Sense Digital Signatures - Regulation of Certifying Authorities Digital Signature Certificates - Duties of Subscribers - Penalties and Offences - The Right to Information Act, 2005 - Right to know - Salient Features of the Act - Obligation of Public Authority - Designation of Public Information Officer - Request for obtaining information - Duties of a PIO - Exemption from Disclosure of Information - Partial Disclosure of Information - Information Commissions - Powers of Information Commissions - Appellate Authorities – Penalties - Jurisdiction of Courts.

TEXT BOOKS

1. Kuchhal M.C, “Business and Industrial Laws”, 3rd Edition, JBA Publishers, New Delhi, 2013.
2. Gulshan S.S, “Merchantile Law”, 3rd Edition, JBA Publishers, New Delhi, 2007.

REFERENCES

1. Mulla D.F, “The Sale of Goods Act and the Indian Partnership Act”, 10th Edition, LexisNexis Ltd., India, 2012.
2. Dabas J, “Negotiable Instruments Act”, 2nd Edition, JBA Publishers, New Delhi, 2013.
3. Avtar S, “The Principles of Mercantile Law”, 9th Edition, Eastern Book Company, India, 2011.

15TD02E

**LEADERSHIP AND PERSONALITY
DEVELOPMENT**

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: identify the various leadership skills.
- CO 2: understand group dynamics and factors influencing the team performance.
- CO 3: describe the personality dimensions based on personality theories.
- CO 4: explain personality determinants and personality types.
- CO 5: apply effective training program for personality development.

UNIT I INTRODUCTION

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership- Leader, Followers and Situations - Leadership Skills – Basic Leadership Skills - Building Technical Competency - Advanced Leadership Skills - Team Building for Work Teams - Building High Performance Teams.

UNIT II TEAMS AND LEADERSHIP

Assessing Leadership & Measuring Its Effects - Group- Nature, Size, Roles, Norms, Cohesion, and Stages of Group Development - Teams and their Leadership – Effective Team Characteristics and Team Building - Ginnetts Team Effectiveness Leadership Model.

UNIT III PERSONALITY

Personality - Meaning, Concept, Personality Patterns, Symbols of Self, Moulding the Personality Pattern, Persistence & Change - Personality & Personal Effectiveness - Psychometric Theories – Cattel and Big Five - Psychodynamic Theories - Carl Jung and MBTI - Transactional Analysis - Johari – Window - Personal Effectiveness.

UNIT IV PERSONALITY DETERMINANTS

Personality Determinants – Heredity and Environment – Types of personality.

UNIT V PERSONALITY TRAINING

Concept, Role, Need, Importance and types of personality Training - Understanding Process of Learning - Developing an Integrated Approach of Learning in Training Programme - Training Needs Assessment.

TEXT BOOKS

1. Yukl G, "Leadership in Organisations", 8th Edition, Pearson Education Ltd., England, 2013.
2. Lall M, Sharma S, "Personal Growth Training & Development", Kindle Edition, USA, 2009.

REFERENCES

1. Janakiraman B, "Training and Development", Wiley Dream tech, Biztantra, 2005.
2. Pareek U, "Understanding Organizational Behaviour", 2nd Edition, Oxford University Press, USA, 2007.

15TD03E

**INTERNATIONAL BUSINESS
MANAGEMENT**

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: understand the global business environment.
- CO 2: explain the impact of economic, legal, cultural, geographical and political factors on international business.
- CO 3: discuss the issues and problems of Multinational Enterprises.
- CO 4: discuss the role of various international financial institutions.
- CO 5: discuss about important aspects of WTO and GATT agreement.

UNIT I INTERNATIONAL BUSINESS ENVIRONMENT

International Business Environment - Globalization - Forces, Meaning, Dimensions and Stages in Globalization - Trading Environment of International Trade - Tariff and Non-tariff Barriers - Trade Blocks.

UNIT II RISK ANALYSIS AND PRACTICES

Country Risk Analysis - Political, Social and Economic - Cultural and Ethical practices - Responsibilities of International Business - Economic crisis in foreign countries.

UNIT III MULTINATIONAL ENTERPRISES

Managing Multinational Enterprises - Problems and Potential - Multinational Service Organizations - Indian companies becoming multinationals - Potential, Need and Problems.

UNIT IV INTERNATIONAL FINANCIAL MANAGEMENT

Introduction to International Financial Management - Balance of Trade and Balance of Payment - International Monetary Fund, Asian Development Bank and World Bank - Financial Markets and Instruments - Introduction to Export and Import Finance - Methods of Payment in International Trade.

UNIT V INTERNATAIONAL AGREEMENT

General Agreement on Trade and Tariffs, (GATT) - World Trade Organization - Seattle and Doha Round of Talks - Dispute Settlement Mechanism under WTO - Problems of Patent Laws - International Convention on Competitiveness - Global Sourcing and its Impact on Indian Industry - Globalization and Internal Reform Process.

TEXT BOOKS

1. Bhalla V.K, Shivaramu S, "International Business Environment", 9th Edition, Anmol Publications Pvt. Ltd., Delhi, 2005.
2. Apte P.G, "International Financial Management", 5th Edition, Tata McGraw Hill, India, 2008.
3. Cherulinam F, "International Business", 5th Edition, Prentice Hall of India, New Delhi, 2010.

REFERENCES

1. Rao, Rangachari, "International Business", Himalaya Publishing House, New Delhi, 2010.
2. Hill C, "International Business", 10th Edition, Tata McGraw Hill Education, New Delhi, 2014.
3. Daniels J.D, "International Business Environment", 15th Edition, Prentice Hall of India, New Delhi, 2014.

15TD04E

BASICS OF MARKETING

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: describe the basic concepts of marketing.
- CO 2: discuss the significance of consumer behavior and market segmentation.
- CO 3: discuss brand, trade mark, after- sales service and product life cycle concepts.
- CO 4: formulate strategies for pricing and channels of distribution.
- CO 5: analyze and selection of best promotional technique.

UNIT I INTRODUCTION

Nature and Scope of Marketing - Importance of Marketing – Concepts: Traditional and Modern - Selling Vs. Marketing - Marketing Mix - Marketing Environment.

UNIT II CONSUMER BEHAVIOR AND MARKET SEGMENTATION

Nature, Scope and Significance of Consumer Behavior - Market Segmentation - Concept and Importance - Bases for Market Segmentation.

UNIT III PRODUCT PLANNING

Concept of Product - Consumer and Industrial Goods - Product Planning and Development - Packaging - Role and Functions - Brand Name and Trade Mark - After- Sales Service - Product Life Cycle Concept.

UNIT IV PRICING AND PHYSICAL DISTRIBUTION

Price - Importance of Price in the Marketing Mix - Factors Affecting Price of a Product/Service - Discounts and Rebates - Distribution Channels - Concept and Role - Types of Distribution Channels - Factors Affecting Choice of a Distribution Channel - Retailer and Wholesaler - Distributions Channels and Physical Distribution.

UNIT V PROMOTION

Definition - Methods of Promotion - Optimum Promotion Mix - Advertising Media - Their Relative Merits and Limitations - Characteristics of an Effective Advertisement - Personal Selling - Selling as a Career - Classification of a Successful Sales Person - Functions of Salesman.

TEXT BOOKS

1. Etzel M.J, Walker B.J, Stanton W.J, “Fundamentals of Marketing”, 13th Edition, McGraw Hill, New York, 2004.
2. Tanner J, Raymond M, “Principles of Marketing”, University of Minnesota Libraries Publishing, New York, 2015.

REFERENCES

1. Rajan Nair N, Varma M.M, "Marketing Management", 2nd Edition, S.Chand & Sons, New Delhi, 2005.
2. Ramaswamy V.S, Namakumari S, "Marketing Management", 3rd Edition, Macmillan India Limited, London, 2002.

15TD05E RETAILING AND DISTRIBUTION MANAGEMENT

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the concepts of retailing and distribution management.
- CO 2: analyze and solve retailers' problems to make decisions in retail organizations.
- CO 3: plan and formulate strategy for retail management process.
- CO 4: discuss about various distribution technology and stores management.
- CO 5: analyze the issues and challenges in Logistic Management

UNIT I INTRODUCTION

Meaning and Nature of Distribution and Retail Industry - Future of Retailing and Distribution in India - Distribution Channels – Concept, Role and Types - Factors Affecting Choice of Distribution Channel.

UNIT II TYPES OF RETAILING

Stores Classified by Owners - Stores Classified by Merchandising Categories - Wheel Of Retailing - Traditional Retail Formats Vs. Modern Retail Formats in India - Store and Non-Store Based Formats - Cash and Carry Business - Retailing Models – Franchiser Franchisee, Directly Owned - Wheel of Retailing and Retailing Life Cycle – Issues in Retailing.

UNIT III MANAGEMENT OF RETAILING OPERATIONS

Meaning - Functions of Retail Management - Strategic Retail Management Process - Retail Planning - Importance and Process - Developing Retailing Strategies.

UNIT IV TECHNOLOGY IN DISTRIBUTION

Bar-Coding – RFID – Electronic Payment Systems - Store Administration - Floor Space Management – Managing Store Inventories and Display Action Plans - Pricing Strategies and Location Strategies.

UNIT V LOGISTICS OF RETAIL MANAGEMENT

Components and Functions; Distribution Related Issues and Challenges - Gaining Competitive Advantage through Logistics Management.

TEXT BOOKS

1. Agrawal D. K., "Distribution & Logistics Management: A Strategic Marketing Approach", Macmillan Publishers India Limited, New Delhi, 2007.
2. Berman B, Evans J.R, "Retail Management – A Strategic approach", 12th Edition, Pearson Education Ltd., England, 2013.
3. Cox R, Brittan P, "Retailing an introduction, Financial Times Management", 5th Edition, Pearson Education Limited, England, 2004.

REFERENCES

1. Rushton A, Croucher P, Baker P, "The Handbook of Logistics & Distribution Management", Kogan Page Limited, London, 2006.
2. Coughlan A.T, Anderson E, Stern L.W, El-Ansary A.I, "Marketing Channels", 7th Edition, Prentice Hall, New Jersey, 2006.
3. Sinha P. K, Uniyal D.P, "Managing Retailing", Oxford University Press, India, 2007.

15TD06E

INTERNATIONAL ECONOMICS

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the impact of globalization.
- CO 2: identify and analyze different theoretical models of international economics in light of 'real world' situations.
- CO 3: examine the consequences of trade policies.
- CO 4: explain the importance of international financial markets.
- CO 5: discuss the important aspects of international banking.

UNIT I INTRODUCTION

Background of International Business Economics - Globalization and International Business – The Emergence of Global Institutions – Drivers of Globalizations - The Globalization Debate.

UNIT II THE INTERNATIONAL TRADE THEORY

The Law of Comparative Advantage – The Demand and Supply, Offer Curves - The Terms of Trade – Factor Endowments and the Heckscher – Ohlin Theory – Implications of Trade Theories - Economics of Scale - Imperfect Competition.

UNIT III INTERNATIONAL TRADE POLICY

Trade Restrictions - Tariffs, Non –Tariff Trade Barriers - Tariff Vs. Quota - The New Protectionism – Economic Integration - Custom Unions and Free Trade Areas - Major Regional Trade Agreements - Foreign Exchange Market – Types of Foreign Exchange Transactions – Reading Foreign Exchange Quotations – Forward and Futures Market – Foreign - Currency Options – Exchange Rate Determination – Arbitrage – Speculation and Exchange - Market Stability.

UNIT IV WORLD FINANCIAL ENVIRONMENT

Global Foreign Exchange Markets – Economic Theories of Exchange - Rate Determination - International Regime for FDI and MNC - Consequences of Economic Globalization.

UNIT V INTERNATIONAL BANKING

Reserves, Debt and Risk - Nature of International Reserves – Demand for International Reserves – Supply of International Reserves – Gold Exchange Standard – Special Drawing Rights – International Lending Risk – The Problem of International Debt – Financial Crisis and The International Monetary Fund – Eurocurrency Market.

TEXT BOOKS

1. Krugman P.R, Obstfeld M, “International Economics Theory and Policy”, 8th Edition, Prentice Hall, Boston, 2008.
2. Carbaugh R.J, “International Economics”, 15th Edition, South Western College publication, USA, 2014.

REFERENCES

1. Daniels J, Radebaugh L, Sullivan D, Salwan P, “International Business”, 12th Edition, Pearson Education, New Delhi, 2010.
2. Suranovic S, “International Economics: Theory and Policy”, Flat World Knowledge, USA, 2010.

15TD07E

INDIAN ECONOMY

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the current economic development in India
- CO 2: describe the key indicators of estimation of national income
- CO 3: explain elementary concepts of economic planning and development in India
- CO 4: discuss the concept of public finance and preparation of budget
- CO 5: discuss the influence of infrastructure growth on economic development

UNIT I ECONOMIC DEVELOPMENT

Meaning - Measurement of Economic Development - Characteristic of underdeveloped and developed economies - Causes for Indian economic underdevelopment - Major issues in development - Strategies for economic development Import substitution and Export oriented strategies - Determinants of economic development.

UNIT II NATIONAL INCOME

The National Income and its estimates in India - Limitations of National income estimation - Trends in National income of India: Growth and Structure - Inter-state variations in National income - Income distribution - Measurement of poverty in India.

UNIT III ECONOMIC PLANNING

Planning and economic development in India - Planning models in India (Elementary concepts) - Capital formation - Growth of Public and Private sector in India – Industrial policies an assessment - Capital formation and domestic saving.

UNIT IV INDIAN PUBLIC FINANCE

Budgetary policies of the central government - Composition and trends in public revenue and expenditure - Expenditure control and government consumption expenditure - concepts of Budgetary deficits and implications - state budget.

UNIT V INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Power and energy - Transport system in India's economic development - Communication system in India - Urban infrastructure - Science and technology - Private investment in infrastructure - Outlook and prospects.

TEXT BOOKS

1. Dutt R, Sundaram K.P.M, "Indian Economy", S.Chand and Co., New Delhi, 2006.
2. Agarwal A.N, Agarwal M.K, "Indian Economy: Problems of Development and Planning", 41st Edition, New Age International Ltd., New Delhi, 2016.

REFERENCES

1. Arvind P, "India: The Emerging Giant", Oxford University Press, USA, 2008.
2. Government of India, Economic Survey, (2010 -11 to 2014 -15).

15TD08E

RURAL ECONOMICS

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the role and importance of agriculture in economic development of India.
- CO 2: describe the impact of agricultural farming in rural employment, wage policy, technological change and green revolution.
- CO 3: analyze the relationship between rural and urban society.
- CO 4: recognize the formation and system of rural social institutions.
- CO 5: compare the social changes in the rural society after modernization and globalization.

UNIT I INTRODUCTION

Nature and Scope of Rural Economy - Importance of Agriculture in Economic Development of India - Nature of Land Problems - Evolution of Policy – Land Tenure System - Land Reform Measures.

UNIT II AGRICULTURE AND FARMING

Agricultural Holdings - Fragmentation and Sub-Division of Holdings, Cooperative Farming-Rural Labour Problems - Nature of Rural Unemployment - Employment and Wage Policy - Sources of Technological Change and Green Revolution.

UNIT III RURAL SOCIETY

Rural Society Structure and Change - Village and its Social Organization - Indian Village and its Types - Rural-Urban Continuum and Rural-Urban Relationships.

UNIT IV RURAL SOCIAL INSTITUTIONS

Rural Social Institutions - Family, Property, Caste, Class, Agrarian Structure - Indebtedness and Poverty - Jajmani System - Religion, Village, Panchayat Raj and Community Development Programmes – Problems.

UNIT V SOCIAL CHANGES

Social Change in Rural India-Impact of Westernization - Secularization, Urbanisation, Industrialisation, Migration, Transportation, Modernization of Indian Rural Society - Post Modernization and Globalization and Indian Villages.

TEXT BOOKS

1. Carver T.N, "The Principles of Rural Economics", Ginn and company, USA, 1911.
2. Desai A.R, "Rural Sociology in India", 5th Edition, Popular Prakashan Ltd., Mumbai, 2011.

REFERENCES

1. Dube S.C., "India's changing villages", Psychology Press, UK, 2003.
2. Datt R, Sundharam K.P.M, Datt G, Mahajan A, "Indian Economy", 72nd Edition, S.Chand & Co., New Delhi, 2016.
3. Chaudhari, C.M., "Rural Economics", Sublime Publication, Jaipur, 2009.

15TD09E

INTERNATIONAL TRADE

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the importance of international trade in developing countries.
- CO 2: describe the impact of Trade agreements in international Business environment.
- CO 3: explain the role of foreign exchange and their impact on trade and investment flows.
- CO 4: discuss the benefits of Multinational Corporation in Internal Trade
- CO 5: analyze the key role of globalisation in Indian economy.

UNIT I INTRODUCTION

International Marketing - Trends in International Trade - Reasons - Global Sourcing and Production Sharing - International Orientations - Internationalization Stages and Orientations - Growing Economic Power of Developing Countries – International Business Decision.

UNIT II INTERNATIONAL BUSINESS ENVIRONMENT

Trading Environment - Commodity Agreements – State Trading - Trading Blocks and Growing Intra-Regional Trade - Regional Groupings – SAARC, BRICS, ECM, ASEAN - Trade Liberalization - The Uruguay Round-Evaluation – UNCTAD – GATT – WTO.

UNIT III INTERNATIONAL FINANCIAL ENVIRONMENT

International Money and Capital Markets - Foreign Investment Flows – Pattern, Structure and Effects - Movements in Foreign Exchange and Interest Rates and their Impact on Trade and Investment Flows - Exchange Rate Mechanism and Arrangement.

UNIT IV MULTINATIONAL CORPORATIONS

Definition - Organizational Structures - Dominance of MNC's - Recent Trends - Code of Conduct - Multinationals in India - Issue in Investment, Technology

Transfer, Pricing and Regulations - International Collaborations and Strategic Alliances.

UNIT V INDIA IN THE GLOBAL SETTING

India an Emerging Market - India in the Global Trade - Liberalization and Integration with Global Economy - Factors Favouring and Resisting Globalization - Trade Policy and Regulation in India - Trade Strategies - Export-Import Policy - Regulation and Promotion of Foreign Trade in India.

TEXT BOOKS

1. Daniels J.D, Radebaugh L.H, Sullivan D.P, "International Business: Environment and Operations", 12th Edition, Prentice Hall, USA, 2009.
2. Ricky W.G, Michael W.P, "International Business: A Managerial Perspective", Prentice Hall, USA, 2009.

REFERENCES

1. Bhattacharya B, Varshney R.L, "International Marketing Management", 25th Revised Edition, S. Chand & Sons, New Delhi, 2015.
2. Verma M.L, "International Trade", Common wealth Publisher, New Delhi, 2010.

15TD10E

GLOBAL CHALLENGES AND ISSUES

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: understand the various global issues.
- CO 2: demonstrate a reasonable understanding of environmental debates and issues.
- CO 3: explain the developmental issues relating to food, health and energy.
- CO 4: demonstrate the economical issues in international trade.
- CO 5: describe the civilization issues relating to human rights and social justice.

UNIT I SECURITY ISSUES

Nuclear Issues - Global and South Asian Context - Small Weapons Proliferation and Internal Arms Race - Chemical and Biological Weapons – Terrorism - Causes, Consequences And Trends - Cyber Terrorism – Counter Terrorism.

UNIT II ENVIRONMENTAL ISSUES

Global Warming and Climate Change - Threats to Bio-Sphere and Space - Pollutions, De-Forestation, Solid, Chemical and Nuclear Wastes and their Management - Preserving the Green Cover and Wild Life.

UNIT III DEVELOPMENTAL ISSUES

Food Security - Poverty and Hunger - Energy Security - Supply and Demand - Traditional and Alternative Sources of Energy – ITER - Health Security – Health for all - Development Vs. Environment - Sustainable Development.

UNIT IV ECONOMIC ISSUES ON INTERNATIONAL TRADE

International Trade - GATT, WTO - Regional Associations - ECM, ASEAN, OPEC, BRICS - Financial Crisis - ASEAN, Mexico and Greece - Global Issues in Trade and Commerce.

UNIT V CIVILIZATION ISSUES

Human Rights - Issues Relating to Freedom of Speech and Expression - Right to Self Determination - Preservation of Cultures and Cultural Diversities - Rights of Women and Children - Dividends of Globalization and Social Justice – Good Governance.

TEXT BOOKS

1. Payne R, “Global Issues”, 4th Edition, Pearson Education Ltd., New York, 2013.
2. Owens P, Baylis J, Smith S, “The Globalization of World Politics”, 3rd Edition, Oxford University Press, USA, 2013.

REFERENCE

1. Chirco J.A, “Globalization: Prospects and Problems”, Sage Publications, New Delhi, 2013.

15TD11E

INDIAN CULTURE AND HERITAGE

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: describe Indian culture, civilization and its features.
- CO2: demonstrate stone age, Indian races and their contribution in pre-historic culture.
- CO3: explain historical development of Indian culture.
- CO4: explain the significance, conditions and development of Vedic culture.
- CO5: analyze the advent of Islam and European culture.

UNIT I INTRODUCTION

Introduction to Culture - Meaning and Scope - Culture and Civilization - General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

UNIT II PRE-HISTORIC CULTURE

Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

UNIT III HISTORICAL DEVELOPMENT OF INDIAN CULTURE

Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic Culture - Importance of Indus Valley and Vedic Cultures.

UNIT IV CULTURE IN SANGAM AGE AND POST SANGAM AGE

Sangam Literature - Society - Political and Economical Conditions - Trade - Religion and Fine Arts.

UNIT V ADVENT OF ISLAM AND EUROPEAN CULTURE

Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

TEXT BOOKS

1. Luniya B.N, "Evolution of Indian Culture", Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, "History of Indian culture", Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, "Indian Culture and Heritage", Neha Publishers & Distributors, New Delhi, 2012.

REFERENCES

1. John G.A, "Dictionary of Indian Philosophy (Sanskrit-English)", University of Madras, Madras, 1998.
2. Misra R.S, "Studies in philosophy and Religion", Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, "Culture and Rationality", Sage publications India Pvt. Ltd., New Delhi, 1988.
4. Suda J.P, "Religious in India", Sterling Publishers Pvt. Ltd., New Delhi, 1978.

15TD12E

INDIAN HISTORY

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: illustrate the basics of Indian cultural heritage.
- CO2: describe interaction between Ancient Indian cultural heritage and Islamic culture.
- CO3: demonstrate Innovation by rulers of medieval period in the area of Administration, and their contact with the Europeans.
- CO4: analyse modern Indian movements, Economic history and Impact of the British rule on India.
- CO5: demonstrate the concepts of Indian National Movement and the history of freedom struggle in India.

UNIT I ANCIENT INDIAN CULTURE

Ancient Indian Cultural Heritage - Social, Political, Legal and in the Area of Religion and Philosophy.

UNIT II LAW RELATING TO CULTURE

Law Givers and Dispute Resolution Systems in Ancient India (Administration of Justice in Ancient India - Pre-Islamic Period) - Law Relating to Culture - The Advent of Islam - Interaction between Ancient Indian Cultural Heritage and Islamic Culture - The Emergence of Synthetic Indian Culture.

UNIT III ADMINISTRATION IN ANCIENT INDIA

Innovation by Rulers of Medieval Period in the Area of General and Revenue Administration - District Administration - Court Systems - Indian Contact with the Europeans.

UNIT IV SOCIO-ECONOMIC HISTORY

Socio-Religious Reform Movements in Modern India and its Legal Culture - Economic History of India During British Period - Impact of the British Rule on India – Education.

UNIT V EUROPEAN CULTURE IMPACT

Impact of European Culture and Liberal Thought on India – The Indian National Movement - The History of Freedom Struggle in India upto 1947.

TEXT BOOKS

1. Sreenivasa M.H.V, "History of India Part I and II", JBA Publishers, New Delhi, 2015.
2. Agarwal R.C, Bhatnagar M, "Constitutional Development and National Movement of India", S. Chand Publishers, New Delhi, 2005.

REFERENCES

1. Altekar S, "State and Government in Ancient India", Motilal Banarsidass Publishers, New Delhi, 2002.
2. Majumdar R.C, "History and Culture of the Indian People", Vol. 2, The Age of Imperial Unity, Bharatiya Vidya Bhavan, New Delhi, 2001

**15TD13E SUSTAINABLE DEVELOPMENT AND PRACTICES L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: recognize the sustainable development and the way to achieve the sustainable development.
- CO 2: outline the concept, factors governing the sustainability and their linkages.
- CO 3: explain the environmental impact assessment and environmental audit.

- CO 4: describe the environmental planning and managing the resources.
CO 5: acquire the knowledge about the environmental problems and their solutions.

UNIT I SUSTAINABLE DEVELOPMENT

Need for Sustainability - Nine Ways to Achieve Sustainability - Economics as the Dismal Science - Population, Resources and Environment.

UNIT II CHALLENGES OF SUSTAINABLE DEVELOPMENT

Concept of Sustainability - Factors Governing Sustainable Development - Linkages among Sustainable Development, Determinants of Sustainable Development - Case Studies on Sustainable Development.

UNIT III ENVIRONMENT IMPACT ASSESSMENT AND AUDIT

Concepts-process-evaluation methodology-EIA and EMS integration-setting up of audit programme - typical audit process - carrying out the audit-benefits of environmental auditing-environmental audit programmes in India.

UNIT IV ENVIRONMENTAL PLANNING

Introduction - Perspective of Environmental Planning - land resource development planning - Planning and managing the natural resources - landscape ecological planning - information and decision of environmental planning - Land use policy in India.

UNIT V ENVIRONMENTAL EDUCATION

Knowledge about the environment - Knowledge about the environment and population growth - Knowledge about the solution and environmental problems - Environmental education (EE) – Strategies for EE – Models for future Environmental Education Systems.

TEXT BOOKS

1. Rogers P, Jalal K.F, Boyd J.A, "An Introduction to Sustainable Development", Earth scan Publications Ltd., UK, 2006.
2. Santra S.C," Environmental Science", 3rd Edition, New Central Book Agency (P) Ltd., London, 2013.

REFERENCES

1. Stavins R.N. "Economics of the Environment: Selected Readings", 5th Edition, W.W. Norton and Company, New York, 2005.
2. Sachs J.D, "The Age of Sustainable Development", Columbia University Press, New York, 2015.

15TD14E

WOMEN IN INDIAN SOCIETY

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate historical perspective about women in Indian society.

CO2: Explain social problems of women.

CO3: Understand the legislation for women protection in India.

CO4: Demonstrate the involvement of women literacy, career and politics.

CO5: Analyse the role of NGO's in women empowerment.

UNIT I INTRODUCTION

A Historical Perspective - Early Vedic, Colonial and Modern Periods - Position of Women in Contemporary India.

UNIT II SOCIAL ISSUES

Issues of Girl Child - Female Infanticide and Foeticide, Sex Ratio, Child Marriage, Dowry and Property Rights - Women's Health and Birth Control - Reproduction - Violence against Women - Domestic Violence - Female Headed Households - Women in the Unorganized Sector of Employment - Women's Work- Status and Problems - Problems of Dalit Women.

UNIT III PROTECTIVE LEGISLATION FOR WOMEN

Protective Legislation for Women in the Indian Constitution - Anti Dowry, SITA, PNDDT, And Prevention Sexual Harassment At Workplace (Visaka Case) - Domestic Violence (Prevention) Act.

UNIT IV WOMEN AND EDUCATION

Formal and Non-Formal Literacy - Post Literacy - Vocational Training - Dual Career Modernization – Women and Politics - Political Status - Global Movements and Indian Movements.

UNIT V ROLE OF NGO'S IN WOMEN EMPOWERMENT

Gender Economy - All India Women's Conference (AIWC) – Women's India Association (WIA) - National Council of Women in India (NCWIE) - Indian Association of Women's Studies – Women Development Cells - Self Help Groups.

TEXT BOOKS

1. Majumdar M, "Social Status of Women in India", Wisdom Press, New Delhi, 2012.
2. Harish R, Harishankar V.B, "Re-Defining Feminisms", Rawat Publications, Jaipur, 2011.

REFERENCES

1. Rathod P.B, "An Introduction to Women's Studies", ABD Publishers, Jaipur, 2010.
2. Ray R, "Hand Book of Gender", Oxford University Press, New Delhi, 2012.

15TD15E

INDIAN CONSTITUTION

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: describe the basic understanding of the Indian Constitution.
- CO2: understand the structure and functions of parliament.
- CO3: demonstrate the organization and working of the Judiciary.
- CO4: understand the structure and functions of state legislature.
- CO5: understand the 73rd and 74th Constitutional Amendments.

UNIT I INDIAN CONSTITUTION

Salient Features - Preamble - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

UNIT II PARLIAMENTARY SYSTEM

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III THE JUDICIARY

Organisation and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

UNIT IV STATE GOVERNMENTS

Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

UNIT V LOCAL GOVERNMENTS

73rd and 74th Constitutional Amendments – Federalism - Center – State Relations.

TEXT BOOKS

1. Basu D.D, "Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

REFERENCES

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, NewDelhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.

15TD16E

BIO MECHANICS IN SPORTS

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: discuss the basics of biomechanics in sports & movement technique accurately.
- CO2: discuss the basics of linear kinematics and its applications in the field of sports.
- CO3: demonstrate the linear kinematics in the field of sports.
- CO4: discuss the basics of angular kinematics and its applications in the field of sports.
- CO5: demonstrate the angular kinematics in the field of sports.

UNIT I INTRODUCTION

Meaning, Aim and Objectives, Importance of Biomechanics in Sports - Types of Motion Linear, Angular, Curvilinear and Circular Motion.

UNIT II LINEAR KINEMATICS

Speed, Velocity, Acceleration, Motion, Projectile Motion – Application of Linear Kinematics in The Field of Physical Education and Sports.

UNIT III ANGULAR KINEMATICS

Angular Speed - Angular Velocity - Angular Acceleration - Relationship between Linear and Angular Motion – Application of Angular Kinematics in the Field of Physical Education and Sports.

UNIT IV LINEAR KINETICS

Mass, Weight, Force, Pressure, Work, Power, Energy, Impulse, Momentum, Impact, Friction, Newton's Law of Motion - Law of Inertia and Types of Inertia.

UNIT V ANGULAR KINETICS

Levers, Equilibrium and Centre of Gravity – Friction and its Types, Centrifugal and Centripetal Force Bio Mechanical Principles Involved in Designing Sports Equipments.

TEXT BOOKS

1. Singh S.K, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2009.
2. McGinnis P.M, "Biomechanics of Sports and Exercise", 2nd Edition, Human Kinetics Publishers, USA, 2004.

REFERENCES

1. Saxena A, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2011.
2. Heyward V.H, Gibson A.L, "Advanced Fitness Assessment and Exercise Prescription", 7th Edition, Human Kinetics, USA, 2014.