GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum and Syllabi For

B.E. (CIVIL ENGINEERING)

(Full Time)

2016

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

THADAGAM ROAD, COIMBATORE - 641 013

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VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE – 641 013

DEPARTMENT OF CIVIL ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

Marching towards the centre of excellence in Engineering and Technology with sustainable development to bring out professionals with futuristic vision.

MISSION

- To mould the students to be good planners, designers, executers and ethical Engineers to serve the society and strive for the development of the nation.
- To make Civil Engineering department a renowned high-tech consultancy centre for various Civil Engineering activities.
- To create a nodal centre for providing consulting services during natural calamities.
- To make this department a centre for research and development activities with field interaction.

GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE – 641 013

DEPARTMENT OF CIVIL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed based on the department mission.

PEO 1: Graduates will achieve a high level of technical expertise in the subjects related to Civil Engineering and also good in communication skills that help them to achieve and succeed in various positions.

PEO 2: Graduates will have a strong understanding in Mathematics and Sciences which are needed for the application of Civil Engineering principles to do Post Graduate programmes and competitive examinations.

PEO 3: Graduates will get interest on the learning processes and inculcate in them professional ethics, moral values and social concern.

GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE – 641 013
DEPARTMENT OF CIVIL ENGINEERING

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and Design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

7. **Environmental and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE – 641 013

DEPARTMENT OF CIVIL ENGINEERING

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Graduates will be able to handle building materials and resources in a sustainable manner.

PSO2: Graduates will excel in the core areas of Civil Engineering such as Structural Engineering, Environmental Engineering, Geotechnical Engineering, Water Resources Engineering, Transportation Engineering etc.

PSO3: Graduates will execute excellence in solving the Civil Engineering problems based on the learned principles and techniques within stipulated time.

PSO4: Graduates will be able to adapt themselves according to the developments in Civil Engineering.

BACHELOR OF ENGINEERING
CIVIL ENGINEERING
2016 REGULATIONS

FIRST SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CHS1Z1	Communication Skills in English	HS	50	50	100	2	2	0	3
2	16CBS1Z2	Engineering Mathematics I	BS	50	50	100	3	2	0	4
3	16CBS103	Applied Physics	BS	50	50	100	3	0	0	3
4	16CBS104	Engineering Chemistry	BS	50	50	100	3	0	0	3
5	16CES105	Materials in Construction	ES	50	50	100	3	0	0	3
PRACTICAL										
6	16CBS106	Physics Laboratory	BS	50	50	100	0	0	4	2
7	16CES107	Engineering Graphics	ES	50	50	100	2	0	4	4
		TOTAL		350	350	700	17	2	8	**22**

SECOND SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CHS2Z1	Technical English	HS	50	50	100	2	2	0	3
2	16CBS2Z2	Engineering Mathematics II	BS	50	50	100	3	2	0	4
3	16CBS2Z3	Materials Science	BS	50	50	100	3	0	0	3
4	16CHS2Z4	Environmental Science and Engineering	HS	50	50	100	3	0	0	3
5	16CES2Z5	Programming in C	ES	50	50	100	3	0	0	3
6	16CES206	Engineering Mechanics	ES	50	50	100	3	2	0	4
PRACTICAL										
7	16CBS207	Chemistry Laboratory	BS	50	50	100	0	0	4	2
8	16CES208	Workshop Practice	ES	50	50	100	0	0	4	2
9	16CES2Z9	Programming in C Laboratory	ES	50	50	100	0	0	4	2
		TOTAL		450	450	900	18	4	12	**26**

One Credit Courses

Semester I 16COC1Z1 Human Values I Compulsory 100 Marks
Semester II 16COCX02 Human Values and Professional Ethics Optional 100 Marks

THIRD SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CBS3Z1	Engineering Mathematics III	BS	50	50	100	3	2	0	4
2	16CES302	Engineering Geology	ES	50	50	100	3	0	0	3
3	16CES303	Mechanics of Solids I	ES	50	50	100	3	0	0	3
4	16CES304	Mechanics of Fluids	ES	50	50	100	3	0	0	3
5	16CPC305	Surveying – I	PC	50	50	100	3	0	0	3
6	16CPC306	Construction Technology	PC	50	50	100	3	0	0	3
PRACTICAL										
7	16CPC307	Survey Practical – I	PC	50	50	100	0	0	4	2
8	16CES308	Strength of Materials Laboratory	ES	50	50	100	0	0	4	2
		TOTAL		400	400	800	18	2	8	**23**

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CBS401	Numerical Methods	BS	50	50	100	3	2	0	4
2	16CES402	Mechanics of Solids II	ES	50	50	100	3	0	0	3
3	16CES403	Applied Hydraulics And Fluid Machines	ES	50	50	100	3	0	0	3
4	16CPC404	Basic Structural Design I (Masonry And Steel)	PC	50	50	100	3	2	0	4
5	16CPC405	Surveying – II	PC	50	50	100	3	0	0	3
6	16CPC406	Water Supply Engineering	PC	50	50	100	3	0	0	3
PRACTICAL										
7	16CPC407	Survey Practical – II	PC	50	50	100	0	0	4	2
8	16CES408	Fluid Mechanics And Machinery Laboratory	ES	50	50	100	0	0	4	2
		TOTAL		400	400	800	18	4	8	**24**

FIFTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CPC501	Structural Analysis I	PC	50	50	100	3	2	0	4
2	16CPC502	Basic Structural Design II (Concrete)	PC	50	50	100	3	0	0	3
3	16CPC503	Water Resources Engineering	PC	50	50	100	3	0	0	3
4	16CPC504	Concrete Technology	PC	50	50	100	3	0	0	3
5	16CPC505	Mechanics of Soils	PC	50	50	100	3	0	0	3
6	16CPC506	Wastewater Engineering	PC	50	50	100	3	0	0	3
PRACTICAL										
7	16CPC507	Environmental Engineering Laboratory	PC	50	50	100	0	0	4	2
8	16CPC508	Soil Mechanics Laboratory	PC	50	50	100	0	0	4	2
		TOTAL		400	400	800	18	2	8	**23**

SIXTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CPC601	Structural Analysis II	PC	50	50	100	3	2	0	4
2	16CPC602	Steel Structures	PC	50	50	100	3	0	0	3
3	16CPC603	Irrigation Engineering and Hydraulic Structures	PC	50	50	100	3	0	0	3
4	16CPC604	Design and Drawing – I (Irrigation and Environmental Engineering)	PC	50	50	100	1	0	4	3
5		Elective – I PE/ Industrial Based Elective	PE	50	50	100	3	0	0	3
6		Elective – II PE	PE	50	50	100	3	0	0	3
PRACTICAL										
7	16CPC607	Computer Aided Building Drawing	PC	50	50	100	0	0	4	2
8	16CPC608	A - Concrete Laboratory B - Highway Laboratory	PC	50	50	100	0	0	4	2
9	16CEE609	Industrial Training/ Internship/ Technical Seminar	EEC	100	-	100	0	0	4	2
		TOTAL		500	400	900	16	2	16	**25**

One Credit Courses

Semester VI 16COCX03 Yoga for Youth Empowerment Optional 100 Marks

SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	16CEE701	Construction Management	EEC	50	50	100	3	0	0	3
2	16CPC702	Foundation Engineering	PC	50	50	100	3	0	0	3
3	16CPC703	Concrete Structures	PC	50	50	100	3	0	0	3
4	16CPC704	Design and Drawing –II (Concrete and Steel)	PC	50	50	100	1	0	4	3
5		Elective – III PE	PE	50	50	100	3	0	0	3
6		Elective – IV PE	PE	50	50	100	3	0	0	3
PRACTICAL										
7	16CEE707	Estimation and Costing	EEC	50	50	100	0	0	4	2
8	16CPC708	Computer Application Laboratory	PC	50	50	100	0	0	4	2
9	16CEE709	Mini Project	EEC	50	50	100	0	0	8	4
		TOTAL		450	450	**900**	16	0	20	**26**

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1		Elective – V PE/OE	PE/OE	50	50	100	3	0	0	3
2		Elective – VI PE/OE	PE/OE	50	50	100	3	0	0	3
PRACTICAL										
3	16CEE801	Project Work	EEC	50	50	100	0	0	16	8
		TOTAL		150	150	**300**	6	0	16	**14**

LIST OF PROFESSIONAL ELECTIVES

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16CPEX01	Fundamentals of Remote Sensing and GIS Applications	PE	50	50	100	3	0	0	3
2	16CPEX02	Railway Engineering	PE	50	50	100	3	0	0	3
3	16CPEX03	Smart Materials and Smart Structures	PE	50	50	100	3	0	0	3
4	16CPEX04	Maintenance and Rehabilitation of Structures	PE	50	50	100	3	0	0	3
5	16CPEX05	Safety in Civil Engineering Practices	PE	50	50	100	3	0	0	3
6	16CPEX06	Finite Element Method	PE	50	50	100	3	0	0	3
7	16CPEX07	Advanced Concrete Design	PE	50	50	100	3	0	0	3
8	16CPEX08	Basics of Dynamics and Aseismic Design of Structures	PE	50	50	100	3	0	0	3
9	16CPEX09	Pavement Engineering	PE	50	50	100	3	0	0	3
10	16CPEX10	Industrial Wastewater Management	PE	50	50	100	3	0	0	3
11	16CPEX11	Airport, Docks and Harbour Engineering	PE	50	50	100	3	0	0	3
12	16CPEX12	Hydrology	PE	50	50	100	3	0	0	3
13	16CPEX13	Experimental Stress Analysis	PE	50	50	100	3	0	0	3
14	16CPEX14	Geotechnical Earthquake Engineering	PE	50	50	100	3	0	0	3
15	16CPEX15	Bridge Engineering	PE	50	50	100	3	0	0	3
16	16CPEX16	Traffic Engineering and Management	PE	50	50	100	3	0	0	3
17	16CPEX17	Ground Improvement Techniques	PE	50	50	100	3	0	0	3
18	16CPEX18	Prefabricated Structures	PE	50	50	100	3	0	0	3
19	16CPEX19	Highway Engineering	PE	50	50	100	3	0	0	3
20	16CPEX20	Prestressed Concrete Structures	PE	50	50	100	3	0	0	3

INDUSTRY NEED BASED ELECTIVE SUBJECTS

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16CIEX01	Highways – State of the Art	PE	50	50	100	3	0	0	3
2	16CIEX02	Environmental Legislations in India	PE	50	50	100	3	0	0	3

LIST OF OPEN ELECTIVES

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16AOEX01	Nano Science and Technology	OE	50	50	100	3	0	0	3
2	16AOEX02	Material Characterizations	OE	50	50	100	3	0	0	3
3	16AOEX03	Electrochemical Technology	OE	50	50	100	3	0	0	3
4	16AOEX04	Polymer Technology	OE	50	50	100	3	0	0	3
5	16COEXO5	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
6	16COEX06	Environmental Management	OE	50	50	100	3	0	0	3
7	16COEX07	Town Planning and Architecture	OE	50	50	100	3	0	0	3
8	16MOEX08	Total Quality Management for Engineers	OE	50	50	100	3	0	0	3
9	16MOEX09	Composite materials	OE	50	50	100	3	0	0	3
10	16MOEX10	Automobile Engineering	OE	50	50	100	3	0	0	3
11	16EOEX11	Renewable Energy Sources and Technology	OE	50	50	100	3	0	0	3
12	16EOEX12	Smart Grid Technology	OE	50	50	100	3	0	0	3
13	16LOEX13	Principles of Communication	OE	50	50	100	3	0	0	3
14	16LOEX14	Microcontrollers and its applications	OE	50	50	100	3	0	0	3
15	16NOEX15	Industrial Automation systems	OE	50	50	100	3	0	0	3
16	16NOEX16	Measurements and Instrumentation	OE	50	50	100	3	0	0	3
17	16SOEX17	Enterprise JAVA	OE	50	50	100	3	0	0	3
18	16SOEX18	Cyber Security	OE	50	50	100	3	0	0	3
19	16SOEX19	Network Essentials	OE	50	50	100	3	0	0	3
20	16IOEX20	Programming in Python	OE	50	50	100	3	0	0	3
21	16IOEX21	BIG Data Science	OE	50	50	100	3	0	0	3
22	16IOEX22	Object Oriented Programming using C++	OE	50	50	100	3	0	0	3
23	16BOEX23	Computational Biology	OE	50	50	100	3	0	0	3
24	16BOEX24	Biology for Engineers	OE	50	50	100	3	0	0	3
25	16BOEX25	Fundamentals of BioEngineering	OE	50	50	100	3	0	0	3

LIST OF ONE CREDIT FOR B.E. CIVIL ENGINEERING

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1.	16COC1Z1	Human Values I	OC	100	-	100	1	0	0	1
2.	16COCX02	Human Values and Professional Ethics	OC	100	-	100	1	0	0	1
3.	16COCX03	Yoga for Youth Empowerment	OC	100	-	100	1	0	0	1

SUMMARY OF CREDIT DISTRIBUTION

B.E. CIVIL ENGINEERING

Sl. No.	Course work subject area	Credits per semester								Total Subject	Total Credit	Percentage of total credit (%)	Range of Total Credit (%) As Per Aicte		In No. of subjects assuming 3 credit subject	
		I	II	III	IV	V	VI	VII	VIII				MIN	MAX	MIN	MAX
1	Humanities and Social Science (HS)	3	6							3	9	4.92	5	10	3	6
2	Basic Science (BS)	12	9	4	4					9	29	15.85	15	20	9	12
3	Engineering Science (ES)	7	11	11	8					13	37	20.22	15	20	9	12
4	Professional Subject-Core (PC)			8	12	23	17	11		25	71	38.80	30	40	18	24
5	Professional subjects electives (PE)						6	6	6	6	12	9.84	10	15	6	9
6	Open Subjects electives (OE)								6	2	6	3.28	5	10	2	3
7	Project, Technical Seminar and Industrial training (EEC)						2	9	8	6	21	10.38	10	15	3	6
	Total	**22**	**26**	**23**	**24**	**23**	**25**	**26**	**14**	**62**	**185**					

16CHS1Z1 **COMMUNICATION SKILLS IN ENGLISH** **Category : HS**

Common to all branches L T P C

2 2 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make the learners understand the usage of basic grammar in English.
- To enhance the learner's speaking skills through appropriate listening practice.
- To instill reading habits to practice communicative tasks and comprehension
- To improve the learner's writing skills through various means
- To enrich the vocabulary of learners for speaking and writing

UNIT I **12 Periods**

Listening - Listening to practice basic pronunciation at phonemic and word level, Listening to informal conversations of exchanging greetings and introducing oneself/others; **Speaking**- Introducing oneself, one's family / friend, speaking about one's place; **Reading**-Reading to practice stress and pause; **Writing**-Autobiographical writing, Letter to seek permission, Letter to issue certificates; **Grammar**- Use of Auxiliary Verbs, Adjectives and Adverbs; **Vocabulary**-Word formation, Synonyms and Antonyms of High frequency words.

UNIT II **12 Periods**

Listening-Listening to Telephone Conversations for taking and leaving messages, making enquiries; **Speaking—**Role-play activities based on real life situations, Narrating daily routines; **Reading**– skimming and scanning, Reading for comprehension with exercises; **Writing**-Advertisements and slogan writing, Imperative instructions, Definitions; **Grammar** – Tenses, Prepositions; **Vocabulary**- Commonly confused words

UNIT III **12 Periods**

Listening -Listening to give instructions, Making requests and responding to requests, Thanking someone and responding to thanks; **Speaking** -Group Discussion on chosen topics, Describing a simple process; **Reading**-Reading and interpreting visual material, Critical reading; **Writing** –Letter to the Editor of a Newspaper, Recommendations; **Grammar**- Impersonal Passive, Subject-verb agreement; **Vocabulary**-Collocation, Word Association

UNIT IV **12 Periods**

Listening-Listening to accept/refuse invitation, Listening to apologize, Listening to congratulate; **Speaking** – Debates on current social affairs; **Reading** –Reading to make inference, Paraphrasing; **Writing-** Personal letter (Inviting your friend to a function, congratulating someone on his / her success, thanking one's friends / relatives); **Grammar** – 'Wh'-questions, Modal verbs; **Vocabulary** -Single word substitutes -Use of abbreviations & acronyms

UNIT V **12 Periods**

Listening -Video Listening to different accents, Viewing Speeches, Viewing English songs, Viewing short films; **Speaking** -Giving impromptu talks, Making presentations on given topics; **Reading** – Extensive reading; **Writing** –Writing General Article, Writing Short Stories; **Grammar** - Common Errors in English; **Vocabulary** –Word Pairs with Repetitive meaning.

Contact periods:

Lecture: 30 periods **Tutorial:30 periods** **Practical: 0 periods** **Total: 60 periods**

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Department of English, Anna University. Mindscapes	*English for Technologists and Engineers.*	*Orient Blackswan, Chennai. 2012*
Sadanand, Kamlesh & Punitha, Susheela	*Spoken English: A Foundation Course (Part 1).*	*Orient Blackswan, Hyderabad. 2014*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Raman, Meenakshi & Sangeetha Sharma	*Technical Communication: Principles and Practice*	*Oxford University Press, New Delhi. 2011*
Vijay, Anbazhagan.J, & Jaishree.N	*Technical English-I*	*Global Publishers, Chennai, 2016*
Rizvi, Ashraf. M.	*Effective Technical Communication*	*Tata McGraw-Hill, New Delhi. 2005*
Rutherford, Andrea. J	*Basic Communication Skills for Technology*	*Pearson, New Delhi. 2001*
Redston, Chris, Cunningham, Gillie	*Face 2 Face: Elementary Student's Book*	*Cambridge University Press, New Delhi. 2009*

EXTENSIVE READING (Not for Examination)

Kalam, Abdul. A.P.J	*Wings of Fire.*	*Universities Press, Hyderabad. 1999.*

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com

COURSE OUTCOMES:

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

CO1: The learner will be able to understand basic grammar and the learner will have sufficient command over language by training his tongue and tuning his ear through apt listening tasks.

CO2: Reading tasks will enable the learner practice phonological and linguistic aspect of learning, help Comprehend and create interest in extensive reading.

CO3: The learner shall be able to write appropriately for a given context and use the right word At the right place.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1			M		M								M			
CO2						M					M					
CO3										H						
16CBS1Z1			M		M	M				H	M		M			

L-Low, M-Moderate (Medium), H-High

16CBS1Z2 **ENGINEERING MATHEMATICS I** **Category : BS**

Common to all branches L T P C

3 2 0 4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To familiarize techniques of matrix algebra including properties of eigen values and eigen vectors.
- To gain the knowledge of hyperbolic functions and application problems in differential calculus.
- To familiarize with functions of several variables and Functions of two variables including extremum problems, Jacobian and Leibnitz rule of integration.
- To perform double and triple integration with relevant to surface area and volume of solid.

UNIT I **MATRICES** **9 + 6 Periods**

Eigen values and Eigen vectors of a real matrix-Characteristic equation-Properties of Eigen values and eigen vectors-Cayley Hamilton theorem - Diagonalization of matrices-Reduction of a quadratic form to canonical form by orthogonal transformation-Nature of quadratic forms.

UNIT II **HYPERBOLIC FUNCTIONS AND DIFFERENTIAL CALCULUS** **9 + 6 Periods**

Hyperbolic and Inverse Hyperbolic functions-Identities- Real and Imaginary parts-Solving Problems using Hyperbolic functions.

Curvature and radius of curvature-Cartesian and polar coordinates- center of curvature and Evolutes-Envelopes and Evolute as envelope of normal.

UNIT III **FUNCTIONS OF SEVERAL VARIABLES** **9 + 6 Periods**

Functions of two variables- Taylor's theorem (statement only) and expansions-Maxima and Minima-Constrained extremum by Lagrange's multiplier method-Jacobians-Differentiation under integral sign

UNIT IV **INTEGRAL CALCULUS** **9 + 6 Periods**

Definite and Indefinite integrals-Substitution rule-Techniques of Integration-Integration by parts-Trigonometric substitutions-Integration of rational function by partial fractions-Integration of irrational functions-Improper integrals.

UNIT V **MULTIPLE INTEGRALS** **9 + 6 Periods**

Beta and Gamma integrals and properties. Double Integrals-Change of order of integration-Double integrals in polar coordinates-Area enclosed by plane curves-Triple integrals-Volume as a triple integral-Transformation to Polar, Cylindrical and Spherical polar coordinates.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:30 Periods** **Practical: 0 Periods** **Total: 75 Periods**

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Veerarajan T	*Engineering Mathematics for Semesters I and II*	*Tata McGraw Hill Publishing Co., New Delhi, 2015.*
Kandasamy P, Thilagavathy K and Gunavathy K	*Engineering Mathematics for I year B.E/B.Tech.*	*S.Chand& Co, Ramnagar, New Delhi, Reprint2013.*
S. Narayanan and Manicavachagom Pillai T.K.	*Calculus, Vol.I , II and III,*	*S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Erwin Kreyszig	*Advanced Engineering Mathematics*	*Wiley & sons (Asia) Ltd, 10th Edition, 2015.*
Ray Wylie.C and Louis Barrett	*Advanced Engineering Mathematics*	*Tata McGraw Hill Company, New Delhi, 2004.*
Grewal B. S	*Higher Engineering Mathematics*	*Khanna Publishers, New Delhi, 43rd Edition, 2014.*
Ramana B V	*Higher Engineering Mathematics*	*Tata McGraw Hill Co. Ltd, NewDelhi, 11th Print, 2010.*
Bali N., Goyal M and Watkins C	*Advanced Engineering Mathematics*	*Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition, 2009.*
Bali N.P and Goyal M	*A text book of Engineering Mathematics*	*University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi,2014*

COURSE OUTCOMES:

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

CO1: Acquire knowledge of eigen values and eigen vectors including properties through matrix theory.

CO2: Understand the hyperbolic functions and applications of differential calculus.

CO3: Acquire fluency in partial differentiation and solving problems related to maxima and minima for more independent variables.

CO4: Understand the standard types of integration and solution to various integrals.

CO5: Understand the multiple integrals and their applications to engineering problems.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H							H	M	M		H	L	
CO2	H	M	M							M				H		
CO3	H	H	H							L				M	L	
CO4	H	H	M	M						M	L	M				
CO5	H	M	M							L	L	M		H	L	
16CBS1Z2	H	H	M	M						M	L	M		H	L	

L-Low, M-Moderate (Medium), H-High

16CBS103 **APPLIED PHYSICS** **Category: BS**

Common to Civil, Mechanical, Production and Industrial Biotechnology branches

L T P C
3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Concepts, types of lasers and its applications, fibre optic principles and its applications.
- Basics of properties of matter & thermal physics
- Origin of quantum physics, Schrödinger's equation and applications.
- Principles of acoustics, ultrasonics and their industrial applications.
- Fundamentals of vacuum science, production and measurement.

UNIT I LASERS & FIBRE OPTICS 9 Periods

Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission –Einstein's coefficients - population inversion – methods of achieving population inversion –Optical Resonator -Types of Lasers – Principle, construction and working of Nd-YAG, CO_2, Semiconductor laser - applications of laser-Hologram.

Introduction – Basic Principles involved in fiber optics- Total internal reflection – Structure of optical fiber –Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change - Classification of optical fiber based on materials, refractive index profile and Modes - Fiber optical communication links-Fiber optic sensors-displacement

UNIT II PROPERTIES OF MATTER & THERMAL PHYSICS 9 Periods

Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity - Bending moment - Depression of a cantilever - Young's modulus by uniform bending - I shaped girders.

Thermal expansion - thermal stress - thermal conductivity - heat conduction in solids - flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment.

UNIT III QUANTUM PHYSICS AND APPLICATIONS 9 Periods

Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- de-Broglie wavelength in terms of voltage, energy, and temperature –Heisenberg's Uncertainty principle – verification – physical significance of a wave function- Schrödinger's Time independent and Time dependent wave equations – Particle in a one dimensional potential well - Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM).

UNIT IV ACOUSTICS & ULTRASONICS 9 Periods

Classification of sound - loudness and intensity - Weber-Fechner law - standard intensity and intensity level - decibel - reverberation - reverberation time - sound absorbing materials - Determination of absorption coefficient - factors affecting acoustics of buildings.

Introduction - properties of ultrasonic waves - production of ultrasonic waves; Magnetostriction effect- Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonics-cavitation - applications- ultrasonic drilling-ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system.

UNIT V VACUUM SCIENCE 9 Periods

Introduction - Importance of vacuum in industries - Pumping speed and throughput - Types of pumps-Rotary vane type Vacuum pump(oil sealed), Diffusion Pump and Turbo Molecular Pump - Measurement of High Vacuum-McLeod Gauge-Pirani Gauge-Penning Gauge - Application to thin film technology.

CONTACT PERIODS:

Lecture: 45 periods Tutorial:0 periods Practical: 0 periods Total: 45 periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Arumugam M	*Engineering Physics*	*Anuradha Publishers, 2010. (Unit I & Unit III)*
P.K.Palanisamy	*Engineering physics-I*	*SciTech Publications (India) Pvt. Ltd, 2015. (Unit II & Unit IV)*
Ganesan S and Iyandurai N	*Applied Physics*	*KKS Publishers, Chennai, 2007.(Unit V)*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Avadhanulu M N and Kshirsagar P G	*A Textbook of Engineering Physics*	*S.Chand and Company Ltd, New Delhi, 2010.*
Gaur R.K. and Gupta S.L	*Engineering Physics*	*Dhanpat Rai Publishers, 2009.*
K.Rajagopal	*Engineering Physics*	*PHI Learning Private limited, New Delhi, 2015.*

COURSE OUTCOMES:

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

CO1: Analyze the construction and working of Nd-YAG, CO_2, Semiconductor lasers. Explain fiber optics and classify fibers based on index profiles and modes. [Familiarity]

CO2: Acquire knowledge in properties of matter and thermal Physics [Application]

CO3: Analyze the dual nature of matter using Heisenberg's Uncertainty principle, Schrodinger's time independent and dependent wave equations. [Assessment]

CO4: Apply piezoelectric detector method for industrial applications. [Usage and Assessment]

CO5: Production & Measurement of vacuum. [Familiarity]

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	M	M	M	M	M						M	M	M	M
CO2	H	H	H	H	H	H	H						M	M	M	M
CO3	M	M			M	M	M						M	M	M	M
CO4	H	H	H	H	H	H	H						M	M	M	M
CO5	H	H	H	H	H	H	H						M	M	M	M
16CBS103	H	H	M	M	H	H	H						M	M	M	M

L-Low, M-Moderate (Medium), H-High

16CBS104 **ENGINEERING CHEMISTRY** **Category : BS**

Common to Civil, Mechanical and Production Engineering branches

L T P C
3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at imparting knowledge of Engineering Chemistry topics which would be useful for students to understand chemistry relevant to conventional engineering fields.

UNIT I WATER TECHNOLOGY 9 Periods

Water - sources - types of impurities, hardness - temporary and permanent – units - ppm and mg/L - estimation of hardness – EDTA method- problems - Boiler troubles - internal treatment – external treatment - lime soda process and ion exchange process - Drinking water – characteristics - colour, odour, turbidity, chloride - treatment - preliminary, primary and disinfection methods - chlorination-breakpoint chlorination, desalination – reverse osmosis.

UNIT II POLYMER TECHNOLOGY 9 Periods

Polymers - definitions of monomer, polymer, functionality, degree of polymerisation – Free radical mechanism -Individual polymers - PVC, PMMA, Teflon, polyamide, poly carbonate, epoxy, polyurethane - preparation, properties and their end users - compounding of plastics - components and functions - fabrication techniques - compression, injection, extrusion and blow moulding - Conducting polymers - structures of polypyrrole, polyaniline and poly acetylene - conduction mechanism of polyacetylene only - Biodegradable polymers – polylactide, starch and cellulose.

UNIT III FUELS AND COMBUSTION 9 Periods

Fuels - classifications - calorific value - Gross and Net-Determination by Dulong's formula - problems - combustion – theoretical air-principle and calculations - solid fuels – Coal - proximate and ultimate analysis - significance- Coke- characteristics - manufacture by Otto Hoffman method - Liquid fuels – petroleum - fractionation - petrol and diesel - knocking of IC engines and diesel engines - octane and cetane number - anti-knocking agents – Biogas – biodiesel.

UNIT IV ENGINEERING MATERIALS 9 Periods

Refractories – classification - properties and manufacture of silica and magnesia bricks; Abrasives-Classification-properties - manufacture of SiC -; Lubricants –solid lubricants (Graphite & Molybdenum sulphide) hydrodynamic mechanism of lubrication – Cement – manufacture - setting and hardening of cement - special cements - Alumina cement, waterproof cement, high early strength cement.

UNIT V CORROSION 9 Periods

Corrosion - Spontaneity - Chemical corrosion- mechanism, nature of oxides – Pilling Bedworth rule - electrochemical corrosion – mechanism - types – galvanic and differential aeration – Galvanic series and importance – Prevention methods - design of materials, cathodic protection techniques (sacrificial anode and impressed current cathode), Inhibitors - Protective coatings - Inorganic coating - electroplating – surface preparation and plating method applied to Cr and Ni and galvanising – Organic coating- paints - constituents and functions.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Vairam S, Subha Ramesh	*Engineering Chemistry*	*Wiley India, 2015.*
Jain. P.C. and Monica Jain	*Engineering Chemistry*	*Dhanpat Rai publications Pvt. Ltd, New Delhi, 16th Edition, 2015.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Dara. S.S, Umare	*Text book of Engineering Chemistry*	*S. Chand Publications, 2004.*
Agarwal C.V.	*Chemistry of Engineering Materials*	*9th Edition, B.S. Publications, 2006.*
Kuriakose, J.C., and Rajaram J	*Chemistry in Engineering and Technology, Vol.1 & II,*	*Tata Mc Graw Hill Publishing company Pvt.Ltd, New Delhi, 2001.*
O.P. Aggarwal, Avinash Aggarwal	*Engineering Chemistry*	*Khanna Publishers, 2010.*
Sivasankar B	*Engineering Chemistry*	*Tata McGraw Hill Publications, 2008.*

COURSE OUTCOMES:

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

CO1: Understand the nature of impurities and the effects of various sources of water, and apply them in treatment them usable for industrial and domestic purposes.

CO2: Know about the different types of polymeric materials, properties and fabrication which match the specific applications.

CO3: Learn the different types of fuels with their compositions, combustion characteristics in engines and apply them in design of combustion chambers.

CO4: Be familiar with the various engineering materials, refractories, abrasives, lubricants and cements with their properties and manufacturing methods which are used in engineering applications.

CO5: Gain the knowledge about corrosion of the machinery they use in their fields and, also to understand the mechanisms and to adopt the preventive measures by various techniques.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	L	M	L	L	L	L	L	M	L	M	M	M	L	
CO2	M	L	L	M	M	L	M	L	L	M	L	M	M	M	L	
CO3	M	L	M	M	L	L	L	L	L	M	L	L	L	L	L	
CO4	H	L	M	L	L	M	M	L	L	M	L	M	M	L	M	
CO5	H	M	L	M	M	M	M	H	M	M	L	M	M	L	L	
16CBS104	H	L	M	M	L	L	M	H	L	L	L	M	M	L	L	

L-Low, M-Moderate (Medium), H-High

16CES105 **MATERIALS IN CONSTRUCTION** **Category : ES**

Civil Engineering branch

L T P C

3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To learn the manufacturing process, types, applications and testing procedures for materials used for construction
- To impart knowledge about basis of recent paradigms, and new materials

UNIT I **STONES, TILES, BRICKS, BUILDING BLOCKS** **9 Periods**

Stones – Types – characteristics – uses - Tiles-types-selection -suitability – uses - maintenance – Bricks –composition – manufacture – types - BIS tests. Hollow concrete blocks, Burnt clay hollow Blocks, Stabilized mud blocks– Selection of Building Blocks.

UNIT II **MATERIALS FOR MORTAR AND CONCRETE** **9 Periods**

Cement Mortar – Manufacturing of cement - different types of cements - hydration - setting and hardening – Preparation and uses of cement mortar – curing - Properties of Water, Sand and M-Sand. Concrete - Selection of materials for concrete - water cement ratio - workability of concrete.

UNIT III **STEEL** **9 Periods**

Steel Properties – types - manufacturing of steel, market forms of steel – angle section, channel section, T-section, I-section, round bars, ribbed mild steel bars and bars for reinforcement.

UNIT IV **TIMBER, BOARDS AND PAINTS** **9 Periods**

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.

UNIT V **MODERN BUILDING MATERIALS** **9 Periods**

Aluminium products - UPVC – crack fillers – light roofing materials – GI Sheets – Glass – water proofing compounds – Neo-prene – thermocole – fiber reinforced plastic – smart concrete and smart bricks.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
S.C. Rangawala	*Engineering materials*	*Charotar Publishing House, New Delhi.2014.*
Surendra Singh	*Engineering materials*	*Vikas Publishing Company, New Delhi.*
R.K.Rajput	*Engineering Materials*	*Revised Edition, S.Chand &Company LTD, New Delhi, 2008.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
P.C.Smith	*Materials of Construction*	*Mc Graw Hill Publications, 1973.*
Janardhana Jha	*Engineering materials*	*Khanna Publishers, New Delhi, 1981.*
Allan Everett	*Materials*	*John Willey & Sons 1978.*
K.S.Jagadish, B.V.Venkataraman Reddy and K.S. Nanjunda Rao	*Alternative Building Materials and Technologies*	*New Age International Pvt. Ltd Publishers, New Delhi.*

COURSE OUTCOMES:

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

CO1: Choose the appropriate materials required for the construction of various structural members.

CO2: Do the necessary tests for testing common building materials used in construction.

CO3: Do construction using the learned techniques.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L	L	M							L		H	L	M	L
CO2	L	M	L	H						L			H	L	M	L
CO3	L	M	H	M	M	L					L		H	L	M	L
16CES105	H	M	L	M	M	L				L	L		H	L	M	L

L-Low, M-Moderate (Medium), H-High

16CBS106 **PHYSICS LABORATORY** **Category : BS**

Common to Civil, Mechanical, Production and Industrial Biotechnology branches

L T P C
0 0 4 2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To have a practical knowledge about the concepts behind physics and the need to apply in the emerging technology.

LIST OF EXPERIMENTS

1. Spectrometer - Diffraction Grating Normal Incidence Method
2. Air Wedge –Determination of thickness of a paper
3. Young's Modulus – Cantilever Bending - Koenig's Method
4. a. Laser - Particle size Determination
   b. Optical fiber - Determination of NA & Acceptance angle
5. Ammeter and Voltmeter Calibration – Low Range
6. Resistance of The Given Coil Of Wire – Carey Foster's Bridge
7. Determination of Band gap Energy of Semiconductor
8. Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.
9. Transistor Characteristics
10. Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia

CONTACT PERIODS:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of the practical classes, the students will be able to

CO1: Determinate all physical properties of any matter, basic idea of calibrating electrical measuring instruments and thereby effectively using it for particular applications.

CO2: Experiment intrinsic characteristic features of electronic devices for electrical and electronic applications.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	M	M	M	M	M						H	H	H	H
CO2	M	M	M	M	M	M	M						L	L	L	L
16CBS106	M	M	M	M	M	M	M						H	L	H	L

L-Low, M-Moderate (Medium), H-High

16CES107	ENGINEERING GRAPHICS	Category : ES
	Common to Civil, Mechanical, Production	L T P C
	Engineering and Industrial Biotechnology branches	2 0 4 4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Geometrical constructions
- Orthographic projections.
- Performing section of solids and development of the same.
- Interpretation of solids.
- Pictorial view of solids

UNIT I GEOMETRICAL CONSTRUCTIONS 15 Periods

Dimensioning-Lettering-Types of Lines-Scaling conventions-Dividing a given straight line in to any number of equal parts- Bisecting a given angle- Drawing a regular polygon given one side-Special methods of constructing a pentagon and hexagon- Construction of curves like ellipse, parabola, cycloid and involute using one method.

UNIT II ORTHOGRAPHIC PROJECTIONS 25 Periods

Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces-Projection of planes-Conversion of pictorial views to orthographic views-Projection of solids - Auxiliary projections.

UNIT III SECTION OF SOLIDS AND DEVELOPMENT 20 Periods

Section of solids- Development of surfaces

UNIT IV INTERPENETRATION OF SOLIDS and PICTORIAL VIEWS 20 Periods

Cylinder and cylinder, cone and cylinder only Isometric projections - Conversion of orthographic views to pictorial views (simple objects).

UNIT V INTRODUCTION TO AUTOCAD 10 Periods

Object Construction: Page layout – Layers and Line types – Creating, Editing and selecting the Geometric Objects. Viewing, Annotating, Hatching and Dimensioning the drawing –Creating Blocks and Attributes

Contact periods:
Lecture: 30 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 90 Periods

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
K.Vengopal	*Engineering Graphics*	*New Age International (P) Limited, 2015.*
Dhananjay.A.Jolhe	*Engineering Drawing*	*Tata McGraw Hill Publishing Co., 2007.*
K.V.Nataraajan	*A text book of Engineering Graphics*	*Dhanalakashmi Publishers, Chennai, 2006.*

M.B.Shah and B.C. Rana	*Engineering Drawing*	*Pearson Education, 2005.*
Luzadder and Duff	*Fundamentals of Engineering Drawing*	*Prentice Hall of India Pvt Ltd, XI Edition, 2001.*
K.L.Narayana and P.Kannaiah	*Text book on Engineering Drawing*	*2nd Ed., Scitech Publications (India) Pvt. Ltd, Chennai, 2009.*

COURSE OUTCOMES:

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

CO1: Represent planes and solids as per international standards.

CO2: Generate and interpret multiple views through development, interpretation and sectional views.

CO3: Generate and interrupt orthographic views.

CO4: Generate and interrupt pictorial views and interpenetration.

CO5: Generate and interrupt perspective views.

CO6: Apply the concept of AUTO CAD in engineering graphics.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H			M		L	H	M		M			M	L	L
CO2		H			M		L	H	M		M			H	M	L
CO3		H			M		L	H	M		M			M	L	L
CO4		H			M		L	H	M		M			H	M	L
CO5		H			M		L	H	M		M			M	L	L
CO6	H	H	H		M		L	H	M		M			H	M	L
16CBS103	L	H	L		M		L	H	M		M			M	M	L

L-Low, M-Moderate (Medium), H-High

16CHS2Z1 **TECHNICAL ENGLISH** **Category : HS**

Common to all branches

L T P C

2 2 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make learners acquire guided listening and speaking skills in both formal and informal contexts.
- To help them develop reading skills by familiarizing them with different types of reading tasks and strategies
- To make them understand advance level of grammar and equip them with writing skills needed for academic as well as workplace contexts.
- To explore the learner to Technical English and Technical Vocabulary.

UNIT I **6+6 Periods**

Listening - Listening to ask for/ give opinions, Listening to persuade/dissuade people, Listening to make complaints, Listening to transfer information; **Speaking** –Role play activities on a formal/corporate context, Delivering Welcome Address- **Reading** – Reading to infer lexical and contextual meaning; **Writing** - Effective use of SMS on Whatsapp/ Hike/ Messenger, Writing E-mails on a business context, Technical style; **Grammar** – Use of relative / reflexive pronouns, Discourse Markers; **Vocabulary**- Homonyms and Homophones

UNIT II **6+6 Periods**

Listening - Listening to express regrets/sympathy/condolences, Listening and Note-taking; **Speaking** – Addressing at an official meeting to deal with problems/ sensitive issues, Discussion on a movie with a poignant social message/ or on a recently read book; **Reading** - Reading a short story or an article from newspaper; **Writing** - Writing a review of a book/movie/music concert/sports event, Graph Description; **Grammar** – Noun/Adjective/Adverbial phrases, Cause and effect expressions; **Vocabulary** - Using phrasal verbs in sentences, Jargon

UNIT III **6+6 Periods**

Listening - Listening to a talk about using quantities, Listening to describe manner and frequency, Listening to expressions of assumptions/inference, Listening to make comparisons; **Speaking** – Making conversation to practice stress, pause, pronunciation and intonation, Introducing the chief-guest; **Reading** - Speed reading – reading passages with time limit - **Writing** – Notice, Agenda and Minutes of meetings; - Elements of Writing Technical articles –**Grammar** - Numerical expressions, Conditional clauses; **Vocabulary** - Same word used as different parts of speech, Register

UNIT IV **6+6 Periods**

Listening - Listening to talks about future events/plans, Listening to a talk about making arrangements, Listening to language of reporting, Viewing a model discussion; **Speaking** – Discussion on a formal/corporate context, Proposing vote of thanks; **Reading** - Reading the job advertisements and the profile of the company concerned; **Writing** - Process Description, Applying for a job with résumé; **Grammar** - Direct and indirect speech; **Vocabulary** – Idioms.

UNIT V **6+6 Periods**

Listening – Listening to expressions of possibility, Listening to expressions of obligations, Listening to expressions of ability, Viewing model interviews; **Speaking** - Mock interview; **Reading** - Note making, Intensive reading; **Writing** – Checklist, - Feasibility / Project report; **Grammar** – Time Statements and Contracted Time Statements; Vocabulary – Nominal Compounds

CONTACT PERIODS:

Lecture: 30 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Department of English, Anna University. Mindscapes	*English for Technologists and Engineers.*	*Orient Blackswan, Chennai. 2012*
Sadanand, Kamlesh & Punitha, Susheela	*Spoken English: A Foundation Course(Part 2)*	*Orient Blackswan, Hyderabad. 2014*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Raman, Meenakshi & Sangeetha Sharma	*Technical Communication: Principles and Practice*	*Oxford University Press, New Delhi. 2011*
Vijay, Anbazhagan.J, & Jaishree.N	*Technical English-II*	*Global Publishers, Chennai, 2016*
Rizvi, Ashraf. M.	*Effective Technical Communication*	*Tata McGraw-Hill, New Delhi. 2005*
Herbert, A.J	*Structure of Technical English*	*The English Language Society, London. 1971*
Michigan,E.A	*Word Power and Speed Reading: English Improvement Series*	*Infinity Books, New Delhi, 2007*
Rajendrapal & Korlahalli. J.S	*Essentials of Business Communication*	*Sultan Chand & Sons*

WEBSITES

1. http://www.usingenglish.com
2. http://www.uefap.com

COURSE OUTCOMES:

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

CO1: The learners will be able to speak convincingly at work place and social contexts through guided listening tasks and different genres and strategies of reading.

CO2: The learner will understand advance level of grammar and write professionally to a larger extent for workplace and general contexts.

CO3: The learners will familiarize themselves with Technical Vocabulary and Technical English.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L		L		L	L					M			M		
CO2	L									H						
CO3	L															
16CBS2Z1	L		L		L	L				H	M			M		

L-Low, M-Moderate (Medium), H-High

16CBS2Z2 **ENGINEERING MATHEMATICS II** **Category : BS**

Common to all branches

L T P C

3 2 0 4

PRE-REQUISITES: Basics of - trigonometry- differential and integral formulae.

COURSE OBJECTIVES:

- To acquire knowledge of techniques of ordinary differential equations leading to engineering problems.
- To acquire knowledge of vector Calculus with engineering applications.
- To gain standard techniques of complex variable applicable to fluid dynamics, heat conduction, and elasticity.
- To develop skill of solving transforms leading to engineering applications.

UNIT I **ORDINARY DIFFERENTIAL EQUATIONS** **9 +6 Periods**

Second and Higher order Differential Equations, Method of variation of parameters- Method of undetermined coefficients-Homogeneous equations of Euler's and Legendre's type-System of Simultaneous first order Linear equations with constant coefficients - Method of reduction of order.

UNIT II **VECTOR CALCULUS** **9 +6 Periods**

Gradient and directional derivative, Divergence and Curl – Irrotational and Solenoidal fields- Vector identities - Line, Surface and Volume Integrals – Green's Theorem in a Plane , Gauss Divergence and Stoke's Theorems (Statements only) –Verifications and Applications.

UNIT III **COMPLEX DIFFERENTIATION** **9 +6 Periods**

Functions of a Complex variable-Analytic functions- Cauchy Riemann equations and sufficient conditions (excluding proof)–Harmonic conjugates–Construction of analytic functions-Conformal mappings: $w=z+a$, az, $1/z$, z^2, e^z , sinz, cosz and Bilinear Transformation.

UNIT IV **COMPLEX INTEGRATION** **9 +6 Periods**

Cauchy's integral theorem, Cauchy's integral formula -Taylor's and Laurent's theorems (Statements only) and expansions – Poles and Residues – Cauchy's Residue theorem – Contour integration – Circular and semi circular contours with no pole on real axis.

UNIT V **LAPLACE TRANSFORMATIONS** **9 +6 Periods**

Laplace transforms- Properties and standard transforms-Transforms of unit step, unit Impulse and error functions –Transforms of periodic functions- Inverse Laplace transforms- Initial and Final value theorems- Convolution theorem (Statement only) and applications - Applications to Solution of Linear differential equations of second order with constant coefficients.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Veerarajan T	*Engineering Mathematics for Semesters I and II*	*Tata McGraw Hill Publishing Co., New Delhi, 2015.*
Kandasamy P, Thilagavathy K and Gunavathy K	*Engineering Mathematics for I year B.E/B.Tech*	*S.Chand& Co, Ramnagar, New Delhi,Reprint2013.*
S. Narayanan and Manicavachagom Pillai T.K.	*Calculus-Vol.III*	*S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Erwin Kreyszig	*Advanced Engineering Mathematics*	*Wiley & sons(Asia) Ltd, 10th Edition, 2015.*
Ray Wylie.C and Louis Barrett	*Advanced Engineering Mathematics*	*Tata McGraw Hill Company, New Delhi, 2004.*
Grewal B. S	*Higher Engineering Mathematics*	*Khanna Publishers, New Delhi, 43rd Edition, 2014.*
Ramana B V	*Higher Engineering Mathematics*	*Tata McGraw Hill Co. Ltd, NewDelhi, 11th Print, 2010.*
Bali N., Goyal M and Watkins C	*Advanced Engineering Mathematics*	*Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition, 2009.*
Bali N.P and Goyal M	*A text book of Engineering Mathematics*	*University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 2014.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the kinds of differential equations and their solutions in the field of engineering.

CO2: Evaluate gradient, divergence and curl and also line, surface and volume integrals in cartesian form and simple coordinate systems and calculate integrals applying Greens, stokes and Gauss theorems.

CO3: Understand the concepts of analytic functions and conformal mappings.

CO4: Evaluate contour integrals using calculus of residues.

CO5: Apply Laplace transform methods to solve differential equations.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H						M	H	H		M		
CO2	H	H	M	M						M		M		H	L	
CO3	H	H	M	H		M				M	M	M		M		
CO4	H	H	M	M		M				M	M	M		M		
CO5	H	H	H	H		H				M	M	H		M	L	
16CBS2Z2	H	H	M	H		M				M	M	M		M	L	

L-Low, M-Moderate (Medium), H-High

16CBS2Z3 **MATERIALS SCIENCE** **Category : BS**

Common to all branches

L T P C

3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The properties of conducting materials.
- The application of magnetic and super conducting materials.
- Application and properties of dielectric and ferro electric materials.
- Applications and properties of Modern engineering materials.
- Nano materials and its properties.

UNIT I CONDUCTING MATERIALS 9 Periods

Introduction to Conductors – classical free electron theory of metals – Draw backs of classical theory – quantum theory - Electrical and Thermal conductivity of Metals – Derivation for Wiedeman – Franz law – Lorentz number –Fermi distribution function - effect of temperature – density of energy states – calculation of Fermi energy- carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS AND DEVICES 9 Periods

Introduction – Properties – elemental and compound semiconductors - Intrinsic and extrinsic semiconductors – properties - Carrier concentration in intrinsic Semiconductor - variation of Fermi level with temperature and carrier concentration - Electrical Conductivity – band gap determination - extrinsic semiconductors - Carrier concentration in P- type and N-type semiconductors – variation of Fermi level with temperature and impurity concentration – Hall effect- Determination of Hall Co-efficient in N type and P type Semiconductor - Applications.

UNIT III MAGNETIC AND SUPER CONDUCTING MATERIALS 9 Periods

Introduction - Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Ferrites - structure and applications. - Magneto optical recording and readout – Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- High Tc superconductors, Applications of superconductors- SQUID, Cryotron, Magnetic levitation.

UNIT IV DIELECTRICS AND FERROELECTRICS 9 Periods

Introduction to dielectric materials – Electric polarization and Dipole moment - Electrical susceptibility – dielectric constant – Various polarization mechanisms in dielectrics - electronic, ionic, orientational and space charge polarization– frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials - Ferro electricity –Ferro electric materials -$BaTiO_3$ – Applications- Ferro electric energy converter.

UNIT V MODERN ENGINEERING MATERIALS 9 Periods

Metallic glasses- preparation of metallic glasses - properties – applications of the metallic glasses - Shape Memory Alloys (SMA) - Characteristics, properties of NiTi alloy - applications of the Shape memory alloys - advantages and disadvantages of SMA - Nanomaterials-synthesis –chemical vapour deposition – Sol Gel – ball Milling – properties of nanoparticles and applications of nanoparticles – Carbon Nanotubes (CNT) – structure – properties – applications of CNTs.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
P.K.Palanisamy	*Engineering Physics–II*	*Scitech Publications (India) Pvt. Ltd 2015 (Unit I, Unit III & Unit IV)*
Dr.Jayakumar .S	*Materials science*	*R.K.Publishers,2008.(Unit II & IV)*
Dr.V.Rajendran	*Material Science*	*Tata McGraw Hill Publications, NewDelhi, 2011.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Charles P.Poole, Jr; Frank J.Owens	*Introduction to Nanotechnology*	*Wiley India, 2012.*
Gaur R.K. and Gupta S.L	*Engineering Physics*	*Dhanpat Rai Publishers, 2009.*
K.Rajagopal	*Engineering Physics*	*PHI Learning Private Ltd, New Delhi, 2015.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the properties of conducting materials. [Familiarity]

CO2: List and analyze the properties of Semiconducting materials and Devices. [Familiarity]

CO3: Identify, analyze the properties and applications of magnetic & super conducting materials. [Familiarity]

CO4: List and analyze the properties of dielectric Ferro electric materials. [Familiarity & Application]

CO5: List the properties and applications of modern engineering materials. [Familiarity & Application]

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M				M	M						L	L	L	M
CO2	M	M	M	M	M	M	M						M	M	M	M
CO3	M	M	M	M	M	M	M						M	M	M	M
CO4	M	M	M	M	M	M	M						M	M	M	M
CO5		M	M	M	M	M	M						M	M	M	M
16CBS2Z3	M	M	M	M	M	M	M						M	M	M	M

L-Low, M-Moderate (Medium), H-High

16CHS2Z4 ENVIRONMENTAL SCIENCE AND ENGINEERING **Category : HS**

Common to all branches L T P C

3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at creating awareness among students and also to inseminate the critical ideas of preserving environment.

UNIT I ENVIRONMENTAL RESOURCES 9 Periods

Natural resources -Forest – benefits, over exploitation, deforestation & consequences – Water - unique features, hydrological cycle & over exploitation – Food -effect of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications - Energy resources - renewable & non-renewable resources - wind, solar and tidal - harnessing methods.

UNIT II ECO SYSTEM AND BIODIVERSITY 9 Periods

Ecology - ecosystem, physical and chemical components of ecosystem, biological components of ecosystem - forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle and carbon dioxide cycle, food pyramid, ecological succession, Biodiversity - types, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity – in situ – ex situ conservation.

UNIT III ENVIRONMENTAL POLLUTION 9 Periods

Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_x, H_2S, CO, CO_2 and particulates, control methods - cyclone separator and electrostatic precipitator - Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollutants Soil pollution - sources, effects and control - Noise pollution - decibel scale, sources, effects and control.

UNIT IV ENVIRONMENTAL THREATS 9 Periods

Acid rain, greenhouse effect, global warming and ozone depletion, disaster management, flood, drought, earthquake and tsunami, Threats to biodiversity - destruction of habitat, habit fragmentation - hunting, over exploitation and man - wildlife conflicts, The IUCN red list categories, status of threatened species.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9 Periods

Sustainable development - sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Pollution control Act, Wild life protection act, Forest conservation act, population growth - exponential and logistic growth, variation in population among nations, population policy, women and child welfare programs, role of information technology in human and health, HIV/AIDS - effects and preventive measures.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Sharma J.P	*"Environmental Studies", 3rd Edition*	*University Science Press, New Delhi 2009.*
Anubha Kaushik and C.P. Kaushik	*"Environmental Science and Engineering", 3rd Edition*	*New age International Publishers, New Delhi, 2008.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
R.K. Trivedi	*Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards", Vol.I&II,*	*Environ Media, 2006.*
G. Tyler Miller Jr	*"Environmental Science", 10th Edition*	*Thomson Brooks/Cole Publishing, 2004.*
Gilbert M. Masters	*Introduction to Environmental Engineering and Science, 2nd Edition*	*Pearson Education, 2004.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: To know about the various environmental resources, the effective utility and problems accompanied in over exploitation.

CO2: To acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.

CO3: To be aware of the source of various types of pollution, their ill effects and preventive methods.

CO4: To understand the environmental threats, Acid rain, Green house effect and Ozone depletion and natural disasters.

CO5: To create an idea about sustainable development and social issues.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L	L	L	M	L	H	M	M	L	L	M	L	
CO2	M	L	L	L	L	L	M	L	L	H	M	L	L	M	L	
CO3	M	L	L	L	L	L	M	M	L	M	M	L	L	M	L	
CO4	M	M	L	L	L	L	M	M	L	L	M	L	L	M	M	
CO5	M	L	M	L	L	L	H	M	L	M	L	L	M	M	M	
16CBS2Z4	M	L	L	L	L	L	H	L	M	M	H	H	L	M	M	

L-Low, M-Moderate (Medium), H-High

16CES2Z5 **PROGRAMMING IN C** **Category : ES**

Common to all branches

L T P C

3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- The Computer and Programming fundamentals
- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input And Output

UNIT I COMPUTER AND PROGRAMMING FUNDAMENTALS 9 Periods

Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software – Generation and classification of programming languages – Compiling – Linking and loading a program – Translator – loader – linker – develop a program – software development – Introduction to OS –Types of OS – Algorithms – Structured programming concept.

UNIT II DATA TYPES AND FLOW OF CONTROL 9 Periods

An overview of C – Programming and Preparation – Program Output – Variables – Expressions, and Assignment, The use of #include, printf(), scanf() – Lexical elements, operators and the C systems – The fundamental data types – Flow of control

UNIT III FUNCTIONS, ARRAYS, POINTERS AND STRINGS 9 Periods

Functions and storage classes - 1D Arrays – Pointers – Call by reference – Relationship between Arrays and Pointers – Pointer arithmetic and element size – Arrays as function argument – Dynamic memory allocation – Strings – String handing functions – Multidimensional Arrays.

UNIT IV ARRAY OF POINTERS, BITWISE OPERATORS, PREPROCESSOR DIRECTIVES 9 Periods

Arrays of Pointers – Arguments to main () - Ragged Arrays – Functions as Arguments – Arrays of Pointers to Functions - Type qualifiers.-Bitwise operators and expressions – Masks – Software tools – Packing and unpacking – Enumeration types – The preprocessor directives.

UNIT V STRUCTURES AND UNIONS, I/O AND FILE OPERATIONS 9 Periods

Structures and Unions – Operator precedence and associativity – Bit fields – Accessing bits and bytes - Input and Output functions – File Processing Functions – Environment variables – Use of make and touch.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Pradip Dey, Manas Ghosh	*Computer Fundamentals and Programming in C, Second Edition*	*Oxford University Press, 2013.*
Al Kelley, Ira Pohl	*A Book on C-Programming in C, Fourth Edition*	*Addison Wesley, 2001.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Stephen G. Kochan	*Programming in C-A complete introduction to the C programming language, Third Edition*	*Sams Publication, 2004.*
Yashavant P. Kanetkar	*Let Us C, 13th edition*	*BPB Publications, 2013.*
Brian W. Kernighan and Dennis Ritchie	*The C Programming Language, Second Edition*	*Prentice Hall Software Series, 1988.*
Stephen Prata	*C Primer Plus, Fifth Edition*	*Sams Publishing, 2005.*

COURSE OUTCOMES:

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

CO1: Articulate the programming environment [Familiarity]

CO2: Write algorithm for solving the given problem statement [usage]

CO3: Use right data types and flow control statement [Assessment]

CO4: Write programs using functions, arrays, pointers and strings [Usage]

CO5: Use right storage classes, preprocessor directives, bitwise operators in programs [Assessment]

CO6: Use structures, unions and files [Usage]

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	H	H		M	M	M	M	L	M	H	H	M	M
CO2	H	H	M	H	H			M	M	M	L	M	H	H	M	M
CO3	H	H	M	H	H			M	M	M	L	M	H	H	M	M
CO4	H	H	M	H	H			M	M	M	L	M	H	H	M	M
CO5	H	H	M	H	H			M	M	M	L	M	H	H	M	M
CO6	H	H	M	H	H			M	M	M	L	M	H	H	M	M
16CBS2Z5	H	H	M	H	H		M	M	M	M	L	M	H	H	M	M

L-Low, M-Moderate (Medium), H-High

16CES206 **ENGINEERING MECHANICS** **Category : ES**

Common to all except ECE, CSE and IT branches

L T P C
3 2 0 4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To analyze the force systems, friction and to study the dynamics of particles, impulse and momentum.

UNIT I INTRODUCTION TO MECHANICS AND FORCE CONCEPTS 9 + 6 Periods

Principles and Concepts – Laws of Mechanics – system of forces – resultant of a force system – resolution and composition of forces – Lami's theorem – moment of a force – physical significance of moment-Varignon's theorem – resolution of a force into force and couple – forces in space – addition of concurrent forces in space – equilibrium of a particle in space.

UNIT II FRICTION 9 + 6 Periods

Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction.

UNIT III GEOMETRICAL PROPERTIES OF SECTION 9 + 6 Periods

Centroids – Determination by integration – moment of inertia – theorems of moment of inertia – Product of Inertia – Principal moment of inertia of plane areas - radius of gyration.

UNIT IV BASICS OF DYNAMICS - KINEMATICS 9 + 6 Periods

Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height.

UNIT V BASICS OF DYNAMICS - KINETICS 9 + 6 Periods

Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy.
Principle of impulse and momentum – Equations of momentum – Laws of conservation of momentum. Impact – Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
S.S. Bhavikatti and K.G. Rajasekarappa	*Engineering Mechanics*	*New Age International Pvt Ltd. 1999.*
S.C. Natesan	*Engineering Mechanics*	*Umesh Publications, 5-B north market, Naisarak, Delhi, 2002.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
F.B. Beer and E.R. Johnson	*Vector Mechanics for Engineers*	*Tata Mc.Graw Hill Pvt Ltd, 10th Edition, 2013.*
S. Timoshenko and Young	*Engineering Mechanics*	*Mc.Graw Hill, 4th Edition, 1995.*
Irving Shames and Krishna Mohana Rao	*Engineering Mechanics*	*Prentice Hall of India Ltd, Delhi, 2006.*
Domkundwar V.M and Anand V. Domkundwar	*Engineering Mechanics (Statics and Dynamics)*	*Dhanpat Rai and Co. Ltd, 1st Edition, 2006.*
Suhas Nitsure	*Engineering Mechanics*	*Technical Publications, Pune, 1st edition, 2006.*
R.C. Hibbeller	*Engineering Mechanics*	*Prentice Hall of India Ltd, 13th Edition, 2013.*
Vela Murali	*Engineering Mechanics*	*Oxford university Press,1st Edition,2010.*

COURSE OUTCOMES:

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

CO1: Analyze the problems related to force systems and friction

CO2: Apply concepts of centre of gravity and moment of inertia

CO3: Solve problems on dynamics, momentum and impulse

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	M	L	L				L		L		L	M	H	L
CO2	L	H	L		L				L		L		L	M	H	L
CO3	M	H	M	L	L				L		L		L	M	H	L
16CBS206	M	H	M	L	L				L		L		L	M	H	L

L-Low, M-Moderate (Medium), H-High

16CBS207	CHEMISTRY LABORATORY Common to Civil, Mechanical, Production and IBT branches	Category: BS L T P C 0 0 4 2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at imparting knowledge of experimental techniques which would be useful for students to apply the practical principles relevant conventional engineering field.

LIST OF EXPERIMENTS

1. Estimation of hardness by EDTA method.
2. Estimation of chloride by Argentometric method.
3. Determination of dissolved oxygen by Winkler's method.
4. Conductometric titration of mixture of strong acid and weak acid using strong base.
5. Potentiometric titration of ferrous iron by dichromate.
6. Estimation of copper in brass by EDTA method.
7. Estimation of Iron by Spectrophotometry
8. Estimation of HC1 by pH titration.

CONTACT PERIODS:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
A.O. Thomas,	*Practical Chemistry*	*Scientific Book Centre, Cannanore, 2003.*
Jeffery G H, Basset J. Menthom J, Denney R.C.	*Vogel's Text book of quantitative analysis, 5th Edition*	*EBS, 1988.*

COURSE OUTCOMES:

Upon completion of the practical classes, the students will be able to

CO1: Understand the nature of hardness, chloride level, pollution level using dissolved oxygen content, iron present in water and analyse them in water.

CO2: Apply the EMF and conductometric measurements in quantitative analysis of substances.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L	M	M	L	L	M	M	L	L	L	M	M	L	L	
CO2	H	L	M	M	L	L	M	M	L	L	L	M	M	L	L	
16CBS207	H	L	M	M	L	L	H	H	L	L	L	M	M	L	L	

L-Low, M-Moderate (Medium), H-High

16CES208 **WORKSHOP PRACTICE** **Category : ES**

Common to Civil, Mechanical, Production Engineering and Industrial Biotechnology branches

L T P C
0 0 4 2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint.
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry and Foundry
3. Half lap Joint and Dovetail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mould for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring – simple house wiring
8. Plumbing

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

Upon completion of the practical classes , the students will be able to

CO1: Use tools and equipments used in Carpentry, Welding, Foundry and Sheet metal.

CO2: Make half lap joint and dovetail joint in carpentry.

CO3: Make welded lap joint, butt joint and T-joint.

CO4: Prepare sand mould for cube, conical bush, pipes and V pulley.

CO5: Fabricate parts like tray, frustum of cone and square box in sheet metal

CO6: Carry out minor works/repair related to electrical wiring and plumbing.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		H	H			M		L	H	M		M	L	M	L	L
CO2			H			M		L	H	M		M	L	M	L	L
CO3			H			M		L	H	M		M	L	M	L	L
CO4			H			M		L	H	M		M	L	M	L	L
CO5			H			M		L	H	M		M	L	M	L	L
CO6		H	H	H		M		L	H	M		M	L	M	L	L
16CBS208		L	H	L		M		L	H	M		M	L	M	L	L

L-Low, M-Moderate (Medium), H-High

16CES2Z9 **PROGRAMMING IN C LABORATORY** **Category : ES**

Common to all branches

L T P C
0 0 4 2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Dynamic memory allocation and command line arguments
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input And Output

PRACTICALS

EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:

1. Operators , Expressions and IO formatting
2. Decision Making and Looping
3. Arrays and Strings
4. Functions and Recursion
5. Pointers
6. Dynamic Memory Allocation
7. Structures
8. Unions
9. Files
10. Command line arguments
11. Mini Project

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

Upon completion of the courses, the students will be able to

CO1: Use appropriate data types and flow control statements [Usage]
CO2: Write programs using functions, arrays, pointers and strings [Usage]
CO3: Write programs using dynamic memory allocation [Usage]
CO4: Implement programs using right storage classes, preprocessor directives, bitwise operators [Usage]
CO5: Work with command line arguments, structures, unions and files [Usage]
CO6: Develop applications using C [Usage]

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	H	H			M	M	M	L	M	H	H	H	M
CO2	H	H	M	H	H			M	M	M	L	M	H	H	H	M
CO3	H	H	M	H	H			M	M	M	L	M	H	H	H	M
CO4	H	H	M	H	H			M	M	M	L	M	H	H	H	M
CO5	H	H	M	H	H			M	M	M	H	H	H	H	H	M
CO6	H	H	M	H	H			M	M	M	H	H	H	H	H	M
16CBS2Z9	H	H	M	H	H			M	M	M	M	M	H	H	H	M

L-Low, M-Moderate (Medium), H-High

16CBS3Z1 **ENGINEERING MATHEMATICS III** **Category: BS**

Common to all Branches

L	T	P	C
3	2	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To gain the knowledge of formation of Fourier series.
- To familiarize with Infinite and finite Fourier transforms functions.
- To be familiar with solution of first and second order differential equations.
- To acquire knowledge of techniques to solve one and two dimensional partial differential equations concerning to engineering applications.

UNIT – I **FOURIER SERIES** **9+6 Periods**

Dirichlet's conditions-Full range Expansions - Odd and even functions- Half range sine and cosine series - Parseval's identity on a Fourier series- Harmonic analysis.

UNIT – II **FOURIER TRANSFORMS** **9+6 Periods**

Fourier integral theorem (statement only) -Infinite Fourier transform pair - Fourier sine and cosine transform pair-Properties -Transforms of simple functions - Parseval's identity on a Fourier transform - Finite Fourier transforms.

UNIT – III **PARTIAL DIFFERENTIAL EQUATIONS** **9+6 Periods**

Formation of partial differential equations - First order PDE - Standard types and Lagrange's type - Linear partial differential second and higher order with constant coefficients - Homogeneous and Nonhomogeneous types.

UNIT - IV **BOUNDARY VALUE PROBLEMS** **9+6 Periods**

Method of separation of variables and Fourier series solution: One dimensional wave equation, one and two dimensional heat flow.

UNIT – V **Z TRANSFORMS** **9+6 Periods**

Z transforms – properties - Inverse Z transforms - Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution to difference equations of second order difference equations with constant coefficients with Z transform.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

1. *Veerarajan T, Transforms and partial differential equations, Tata McGraw Hill Publishing Co., New Delhi, 2015.*
2. *Kandasamy, Thilagavathy and Gunavathy, Engineering Mathematics for III Semester B.E/B.Tech, S.Chand & Co, Ramnagar, New Delhi, 2013.*

Reference Books:

1. *Grewal B .S, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2014.*
2. *Ramana B. V, Higher Engineering Mathematics, Tata McGraw Hill Co. Ltd., New Delhi, 11th Edition, Reprint, 2010.*
3. *Bali N., Goyal M, Transforms and Partial differential equations, University Science Press, New Delhi, 2010.*
4. *Ray Wylie C and Louis C Barrett, Advanced Engineering Mathematics, McGraw Hill Education (India) Pvt Ltd, New Delhi, 6th Edition, Reprint ,2014.*
5. *Donald. A. McQuarrie, Mathematical Methods for Scientists and Engineers, Viva Books Pvt. Ltd, New Delhi, Ist Edition, Reprint 2015.*

COURSE OUTCOME:

CO1: Understand the concepts of Fourier series and its construction when discrete and continuous form is known.
CO2: Acquire fluency in Fourier transforms in order to solve improper integrals.
CO3: Understand the standard and special types of partial differential equations.
CO4: Gain fluency in solving boundary value problems.
CO5: Understand the Z transform methods to find solutions of difference equations.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H							H					M	L
CO2	M	H	M							M					M	L
CO3	H	M								L					M	L
CO4	H	H	M			M				M	M				M	L
CO5	M	M	M												M	L
16CBS3Z1	H	H	H			M				H	M				M	L

L-Low, M-Moderate (Medium), H-High

16CES302 **ENGINEERING GEOLOGY** **Category: ES**

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- At the end of this course the students will be able to understand the importance of geological knowledge such as earth, earthquake and volcanism.
- To apply geological knowledge in projects such as dams, tunnels, bridges, roads and harbor as well as to choose types of foundation.
- To imparts knowledge about the methods used to explore the sub surface for natural resources.

UNIT - I: GENERAL GEOLOGY (09)

Interrelationship between Geology and civil engineering – Branches of Geology – Earth Structure and composition –Geological processes – Weathering – work of rivers, sea, wind and their Engineering significance- Earthquakes –Earthquake Zones in India - Volcanoes – Ground water – Origin, Occurrence, Properties of rock – Geological work of ground water – Importance in Civil Engineering.

UNIT – II: MINERALOGY (09)

Elementary knowledge on symmetry elements of important Crystallographic systems – Physical properties of minerals – Study of the following rock forming minerals – Quartz family, Felspar family, Augite, Hornblende, Biotite , Muscovite, Calcite, Garnet. Ore minerals - Hematite, Magnetite, Bauxite, Graphite, Magnesite – Clay minerals – Properties and Engineering significance.

UNIT – III: PETROLOGY (09)

Formation and Classification of rocks and their distinctive properties – Description, Occurrence, Engineering properties and Distribution of the 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, phyllite, Gneiss and schist.

UNIT – IV: STRUCTURAL GEOLOGY (09)

Attitude of beds Dip and Strike - Uses of Clinometer compass – Outcrops – Geological maps – their uses – Structural features – Folds, Faults, Unconformities and Joints – their significance on engineering constructions.

UNIT – V: INTRODUCTION TO GEOLOGICAL INVESTIGATIONS (09)

Geophysical investigations – Seismic and electrical resistivity methods – Aerial Photo and satellite imageries-Interpretation of remote sensing data-Exploration for ground water – Geological investigations pertaining to Dam and Reservoir, Tunnels and Road cuttings – Landslides – causes and prevention – Sea erosion and coastal protection.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Parbin Singh, "Engineering and General Geology", Katson Publication House, 2004.*
2. *Bangar.K.M, "Principles of Engineering Geology", Standard Publishers& Distributors, 1705-B, Naisarak, Delhi-2009.*
3. *S.M.Mathur, "Elements of Geology", PHI learning private limited New Delhi,2010.*

Reference Books:

1. Legget, "Geology and Engineering", McGraw Hill Book company, 1998 Blyth, "Geology for Engineers", ELBS 1995.

2. Krynine and Judd, "Principals of Engineering Geology and Geotechnics" Tata McGraw Hill, New Delhi,2005.

COURSE OUTCOME:

CO1: The student shall be able to understand about geological formations, Causes of Earthquake,volcano.

CO2: Students shall also be able to identification, properties and uses of minerals.

CO3: Students will be able to understand the Engineering properties of rocks.

CO4: Students will be able to fundamental knowledge in structural geology.

CO5: The importance of the study of geology for Civil Engineers with regard to founding structures like dams, bridges, buildings, etc.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M									H		M		L		
CO2						L									M	
CO3		L							M		M		M	M		
CO4				M		H		L			H	M		H		M
CO5			L		M		H			H	M	H	H			H
16CES302	M	L	L	M	M	H	H	L	M	H	M	M	H	H	M	H

L-Low, M-Moderate (Medium), H-High

16CES303 MECHANICS OF SOLIDS – I Category: ES

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CES206 Engineering Mechanics

COURSE OBJECTIVES:

- To determine the stresses, strains and its relation in simple and compound systems.
- To analyze trusses for member forces and to solve complex stress problems.
- To understand the behaviour of beams in bending and twisting.

UNIT – I: STRESS AND STRAIN (09)

Stress and Strain at a point – Hooke's law –Relationship among Elastic constants – Stress Strain Diagram for Mild Steel, TOR Steel, Concrete – Principle of superposition - Bars of Varying sections – Compound Bars - Thermal Stresses and Strains - Strain Energy due to Axial Force – Resilience – Stresses due to Impact and Suddenly Applied Load.

PLANE TRUSSES: Analysis of Plane Trusses – Method of Joints – Method of Sections.

UNIT – II: SHEAR AND MOMENT IN BEAMS (09)

Beams and Bending – supports and loads - Shear Force and Bending Moment Diagrams for determinate beams – Relationship between Rate of Loading, Shear Force, Bending Moment – Point of Contra Flexure.

UNIT - III: SHEAR AND BENDING STRESSES (09)

Theory of Simple Bending – Analysis of Beams for Stresses - Stress Distribution at a Cross Section due to Bending Moment and Shear Force for determinate beams - Flitched Beams – Combined Direct and Bending Stresses – Condition for No Tension in a section – Strain Energy due to Flexure, Transverse Shear – Shear Stress Distribution.

UNIT - IV: TORSION (09)

Torsion of Circular and Hollow Shafts –Elastic Theory of Torsion - Stresses and Deflection in Circular Solid and Hollow Shafts – Stepped Composite Shafts – Combined Bending Moment and Torsion on Shafts – Strain Energy due to Torsion –Modulus of Rupture – Power Transmitted to a Shaft – Shafts in Series and Parallel –Closed and Open Coiled helical Springs – Leaf Springs – Springs in Series and Parallel – Design of Buffer Springs.

UNIT – V: COMPLEX STRESSES (09)

Stresses in a Tensile Member – Stresses due to pure Shearing – Two mutually Perpendicular direct stresses – Principal Planes and Principal Stresses –Two-Dimensional Stress System – Graphical method – Mohr's circle – Combined bending and torsion – Analysis of strain – Principal Stresses and Principal Planes– Principal Strains and Direction – Graphical Method.
Thin walled pressure vessels – Cylindrical shells – spherical shells.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0Periods Practical:0Periods Total: 45 Periods

Text Books:

1. *Sadhu Singh, "Strength of Materials", Khanna publishers, New Delhi, 2013.*
2. Vaidyanathan.R, Perumal.P and Lingeswari.S, "Mechanics of Solids and Structures, Volume I", Scitech Publications Pvt Ltd, Chennai, 2006.
3. Rajput.R.K, "Strength of Materials", S. Chand & Co., New Delhi, 2014.

Reference Books:

1. Prasad.I.B, "Strength of Materials", Khanna Publishers, New Delhi, 1998.
2. Robert L.Mott, "Applied Strength of Materials", PHI Learning Pvt Ltd.," New Delhi, 2009
3. Jhunarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol. I, Charotar Publishing House, NewDelhi,1997.
4. Punmia B C, Jain Ashok and Jain Arun. "Strength of Materials and Theory of structures" – Vol.1, Laxmi Publications Pvt. Ltd., New Delhi, 2000
5. Bansal R K "Strength of Materials", Laxmi Publications, New Delhi, 2010.

COURSE OUTCOME:

- **CO1:** Familiarize the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for elastic solids and to learn the concept of trusses.
- **CO2:** To analyze the problems on bending of simple beams and twisting and to learn about stress distribution in beams.
- **CO3:** To recognize the concept of strain energy in beams of simple and composite sections.
- **CO4:** To familiarize the concept of springs.
- **CO5:** To recognize the concept of state of stress and principal stresses and strains.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H			M	H			M		M			M	M	H	M
CO2	H			H	M			L		M				M	M	L
CO3	H			M	M			M		M	H			M	H	M
CO4	H			H	M			H		M				M	M	
CO5	H			H	M			L		M	M			M	M	
16CES303	H			H	M			L		M	H		M	M	M	M

L-Low, M-Moderate (Medium), H-High

16CES304 **MECHANICS OF FLUIDS** **Category: ES**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.16CBS1Z2 Engineering Mathematics I
2.16CES206 Engineering Mechanics

COURSE OBJECTIVES:

- To understand the properties and behaviour of fluid at static and dynamic conditions.
- To Apply the static and dynamic concepts in solving various fluid flow problems.

UNIT – I : BASIC CONCEPTS AND FLUID STATICS (10)

Dimensions and Units - Continuum Concept - CGS, MKS and SI systems – properties of fluids - Density, Specific gravity, viscosity, surface tension, capillarity and elasticity, compressibility, vapour pressure - Control Volume - Fluid statics - Pascal's Law - pressure measurement - piezometer and manometers – Hydrostatic forces on plane and curved surfaces - Stability of Floating Bodies - Buoyancy – metacentre and metacentric height - simple problems.

UNIT – II : PRINCIPLES OF MASS (08)

Basic principles of fluid flow – classification of flow - types flow line – continuity equation - one dimensional and three dimensional – velocity, tangential, normal, local and convective acceleration, types of fluid motions, potential and stream function - Free and Forced vortex flow.

UNIT – III : PRINCIPLE OF ENERGY (08)

Energy and its forms, Energy equation – Euler's and Bernoulli's equation – Applications venturimeter - orifice meter - pitot tube - Flow over notches and weirs – Other Flow measuring devices.

UNIT – IV : FLOW THROUGH CONDUITS (09)

Laminar flow between parallel plates – laminar flow in pipes - Hagen Poisullie equation for flow through circular pipes - turbulent flow in pipes – Darcy - Weisbach formula for flow through circular pipes - Moody diagram – Impulse Momentum principle.

UNIT – V : BOUNDARY LAYER AND FLOW AROUND IMMERSED BODIES (10)

Concepts of Boundary layer - Definition - Boundary layer on a flat plate - Thickness and classification - Displacement, energy and momentum thickness - Boundary layer separation and control – circulation - Flow around submerged objects - Drag and lift on immersed bodies.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Dr.D.S.Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K.Kataria & Sons, Newdelhi, 2009.*
2. *Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics, Including Hydraulic Machines", Standard Book House, Newdelhi, 2002.*
3. *S.Ramamurtham and R.Narayanan, "Hydraulics and Fluid Mechanics and Fluid Machines", Dhanpat RaiPublishing Co (P) Ltd, NewDelhi, 2000.*

Reference Books:

1. Streeter, Victor L., Wylie, E.Benjamin , - Fluid Mechanics, McGraw -Hill., 1998.
2. Kumar.K.L., - Engineering FluidMechanics, Eurasia Publishing Houses (P) Ltd., NewDelhi, 2000.
3. Natarajan M.K,- Principles of Fluid Mechanics Anuradha Agencies, Vidayal Karuppur, Kumbakonam, 1995.
4. Nagaratnam, S., Fluid Mechanics, Khanna Publishers, 1995.
5. JagdishLal, Hydraulics and Fluid Mechanics, Tata McGraw Hill, 2001.

COURSE OUTCOME:

CO1: Understand the properties of fluids and fluid statics.

CO2: Solve the problems such as finding the particle paths and stream lines using various principles of fluid statics and dynamics.

CO3: Apply the principles of Euler's equation, Bernoulli's equation, energy and momentum equations in real situation of fluid problems.

CO4: Understand the fluid flow behavior through pipes and parallel plates.

CO5: Assess the concept of boundary layer separation, circulation, drag and lift on immersed bodies.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M		M			M			L	M			H	H	M
CO2	M	M	L	M			M			M	M			H	H	M
CO3	L	M	M	H			M			M	M			H	H	M
CO4	L	M	L	M			M			M	M			H	H	M
CO5	L	M	M	M			M			M	M			H	H	M
16CES 304	L	M	M	M			M			M	M			H	H	M

L-Low, M-Moderate (Medium), H-High

16CPC305 **SURVEYING - I** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand basic principle and concepts of different surveying methods.
- To study the different surveying equipments in the field of civil engineering.
- To enhance the ability to calculate surveying quantities.
- To enable the suitability of surveying instruments and method to a given problem.

UNIT – I : INTRODUCTION AND CHAIN SURVEYING (09)

Definition and Principles of Surveying – Applications - Classification – Field and Office work – Scales – Conventional Signs. Chain Survey - Instruments – Ranging – Types - Obstacles in Chaining – Chain and Tape corrections - Setting out Perpendiculars – Well conditioned Triangles – Traversing – Enlarging and reducing Maps – Topological maps.

UNIT – II : COMPASS SURVEYING AND PLANE TABLE SURVEYING (09)

Prismatic Compass – Surveyor's Compass – Working and use of compass - Bearing – Systems and Conversions – Computation of angles from bearing - Local Attraction - Magnetic Declination – Dip – Traversing – Adjustment of error. Plane Table and Accessories – Radiation, Intersection, Resection – Two point problem - Three point problem.

UNIT – III : LEVELLING AND APPLICATIONS (09)

Basic Terms - Types of Level – Fundamental Axes - Levelling staff – Bench Marks – Temporary and Permanent Adjustments – Types of Levelling - Curvature and Refraction correction - Reciprocal Levelling – Calculation of Areas and Volumes – Contouring – Characteristics and Uses of Contours – Methods of contouring.

UNIT – IV : THEODOLITE SURVEYING (09)

Theodolite – types – Terms - Temporary and Permanent Adjustments – Measurement of Horizontal Angles by Repetition and Reiteration – Closing Error and Distribution – Omitted Measurements.

UNIT – V : CURVES (09)

Simple curves - elements - Setting out of curves -Linear and angular methods - Difficulties in setting out - Compound and Reverse curves- elements - Setting out of Vertical Curves.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Kanetkar .T.P, and Kulkarni .S.V, "Surveying and Levelling, Vol. I & II", Pune Vidyarthi Griha Prakashan ,2004.*
2. Duggal S.K ."Surveying ,Vol. I & II", Tata McGraw-Hill, Publishing Company, 2004.
3. Basak N.N, "Surveying and Leveling", Tata McGraw-Hill, Publishing Company, 2014.
4. Bhavikatti S.S, "Surveying and Leveling , Vol.I", I.K. International Pvt. Ltd., 2010.

Reference Books:

1. Charles D Ghilani, Paul R Wolf., Elementary Surveying, Prentice Hall, 2012. .
2. Bannister. A & Reynolds. S, "Surveying", ELBS, 1992.
3. Chandra A.M., "Plane Surveying", New Age International Pvt. Ltd, 2015.

COURSE OUTCOME:

CO1: Able to calculate distances, angles.

CO2: Able to understand about compass and plane table.

CO3: Able to interpret survey data and compute areas and volumes

CO4: Able to calculate levels of various points

CO5: Able to know about setting out of curves.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M		L					M							
CO2	L			M					L					L		
CO3		M							H							
CO4	M	H									L			M		
CO5	L			M									L			
16CPC305	L	M		M					H		L		L	M		

L-Low, M-Moderate (Medium), H-High

16CPC306 **CONSTRUCTION TECHNOLOGY** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CES105 Materials in Construction**

COURSE OBJECTIVES:

- To study the different types of foundations, masonry works, flooring and roofing.
- To understand the various types of doors, windows, plastering and paintings.

UNIT – I : FOUNDATION (09)

Functions of foundation – Types of shallow and deep foundations – caissons and cofferdam – Causes for failures of foundations and remedial measures – setting out of foundation – excavation and timbering – Dewatering techniques.

UNIT – II : MASONRY (09)

Stone masonry – classification – supervision of stone masonry – brick masonry – classification – Supervision of brick masonry – comparison of brick and stone masonry – Defects in brick masonry – Composite masonry – Types of wall – Arches and Lintels – Scaffolding.

UNIT – III : FLOORING AND DAMP PROOF COURSE (09)

Requirements of good floor – floor finishing – classifications – suitability of floors for various applications – damp proof course – causes and effect of dampness – materials and methods of damp proofing – Anti-termite treatment.

UNIT – IV : STAIRS AND ROOFING (09)

Stairs – requirements – dimensions – Classifications of stairs – Ramps and Escalators. Roofs – requirements – Types – Pitched roof – Flat roof – flat slab – ribbed slab.

UNIT – V : DOORS, WINDOWS, PLASTERING AND PAINTING (09)

Doors: Location – size – door frames – types of doors based on mode of opening, material and structural form –fixing of doors.
Windows: Location – size – types of windows based on mode of opening, material and structural form.
Plastering: Materials and methods of plastering – types of plaster finishes – Defects in plastering – pointing.
Painting: Paints and painting – classification of paints – painting on new and old surfaces of steel, timber and masonry wall – defects in painting.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, "Building construction", Laxmi Publications Pvt. Ltd, 2016.*
2. Bindra.S.P and Arora.S.P, "Building construction", Dhanpat Rai Publication Pvt. Ltd., 2010.
3. Rangwala, "Building construction", Charotar Publishing House Pvt. Ltd., 2016.

Reference Books:

1. Edward Allen, Joseph Iano, "Fundamentals of Building Construction: Materials and Methods", Wiley Publishers, 2014.
2. Maden Mehta, "Building Construction", Pearson Education Publishers, 2016.
3. Chudley R, "Building Construction", Elsevier Publications, 2008.
4. Varghese P.C, "Building Construction", Prentice Hall of India, 2012.
5. Sushil Kumar, "Building Construction", Standard Publishers and Distributors, 2010.

COURSE OUTCOME:

CO1: The students can able to choose the appropriate type of foundations for building construction.

CO2: The students can acquire knowledge on different masonry.

CO3: The students can able to select the suitable type of floors for practical applications and dampness preventing methods.

CO4: The student shall have a reasonable knowledge about stairs and roofs.

CO5: The student shall apply knowledge for selection of doors, windows and paints for buildings.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		L			M			L	L				L	M	L
CO2	L				H	M	L						L	L		L
CO3				L	M	L						L	H	L	M	L
CO4				L	M	L						L		L		L
CO5	L			M	H	L	L		L				M	L	M	L
16CPC 306	L		L	L	H	L	L		L	L		L	H	L	M	L

L-Low, M-Moderate (Medium), H-High

16CPC307 **SURVEY PRACTICAL - I** **Category: PC**

PRE-REQUISITES:

L	T	P	C
0	0	4	2

1. **16CPC305 Surveying – I**

COURSE OBJECTIVES:

- To enhance the ability to measure different surveying measurements.
- To enable the handling of various surveying equipments.
- To apply suitable surveying methods and instruments for a given problem.

LIST OF EXPERIMENTS

1. Chain Surveying (Ranging and Chaining)
2. Chain Surveying – Area of polygon
3. Compass Surveying – Intersection method
4. Compass Surveying - Traversing
5. Plane table surveying - Intersection method
6. Plane table surveying - Three point Problem
7. Plane table surveying – Two point problem
8. Levelling – Simple and Differential Levelling
9. Fly Levelling and Check Levelling
10. Setting out a Building

CONTACT PERIODS:

Lecture:0 Periods **Tutorial:0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOME:

CO1: The student will be able to handle the surveying instruments like Chain, Compass, Plane table and Dumpy level.

CO2: The Student will be able to measure distances.

CO3: The Student will be able to measure angles.

CO4: The Student will be able to conduct field survey and collect data.

CO5: The Student will be able to calculate levels

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1			L						M				L			
CO2		M												L		
CO3		M									M			L		
CO4		M	L						L						L	
CO5	L								L							
16CPC307	L	M	L						L		M		L	L	L	

L-Low, M-Moderate (Medium), H-High

16CES308 STRENGTH OF MATERIALS LABORATORY Category: ES

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. **16CES206 Engineering Mechanics**
2. **16CES303 Mechanics of Solids – I**

COURSE OBJECTIVES:

- To find the strength properties of different construction materials like steel, concrete, brick and timber
- To evaluate stiffness properties of springs and to find the hardness properties of various metals.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Tension test on tor steel rod.
3. Torsion test on mild steel bar.
4. Tension and compression test on springs.
5. Compression test on bricks and concrete cubes.
6. Water absorption test on bricks.
7. Hardness test on different metals.
8. Compression and bending test on wood specimens.
9. Deflection test on simply supported beams (for different metals).
10. Deflection test on cantilever beams (for different metals).
11. Bending test on rolled steel joist
12. Flexure test on tiles
13. Charpy and Izod Impact Test
14. Double shear test

CONTACT PERIODS:
Lecture:0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Able to determine the tensile strength of materials

CO2: Able to obtain bending properties of structural materials

CO3: Able to determine the hardness properties of the materials

CO4: Able to predict the compressive strength of the materials

CO5: Able to obtain the impact and torsional strength of the materials.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H				M			L				H		L	
CO2	H	H				M			L				H		L	
CO3	H	H				M			L				H		L	
CO4	H	H				M			L				H		L	
CO5	H	H				M			L				H		L	
16CES308	H	H				M			L				H		L	

L-Low, M-Moderate (Medium), H-High

16CBS401	NUMERICAL METHODS (*Common to Civil, Mechanical and Electrical Engineering*)	Category: BS			
		L	T	P	C
		3	2	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To familiarize with numerical solutions of equation with one variable and system of equations.
- To obtain the knowledge of numerical interpolation, numerical differentiation and numerical integration.
- To acquire knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques.
- To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.

UNIT I: SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS (9+6)

Iterative Method - Newton Raphson Method For Single Variable and Simultaneous Equations With Two Variables -Solutions of Linear System of Equations - Gauss Elimination, Gauss Jordan, Gauss Seidel Method - Eigen Value of Matrix By Power Method.

UNIT II: INTERPOLATION (9+6)

Operators - Relation between the Operators - Newton's Divided Difference Formula - Lagrange's and Hermite's Polynomials - Newton Forward and Backward Difference Formula - Stirling's and Bessel's Central Difference Formulae.

UNIT III: NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION (9+6)

Numerical Approximation of Derivatives Using Interpolation Polynomials - Numerical Integration By Trapezoidal, Simpson's One Third and Simpson's Three Eighth Rules - Two Point and Three Point Gaussian Quadrature Formula - Double Integration Using Trapezoidal and Simpson One Third Rule - Difference Equation.

UNIT IV: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS(9+6)

Taylor Series Method - Euler Method - Modified Euler Method - Fourth Order Rungekutta Method for Solving First Order Equations - Predictor and Corrector Methods: Milne's and Adam Bashforth Methods.

UNIT V: NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (9+6)

Finite Difference Solutions For the Second Order Ordinary Differential Equations - Finite Difference Solutions for One Dimensional Heat Equation (Both Explicit and Implicit Methods) - One Dimensional Wave Equation - Laplace and Poisson Equation.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

1. *Kandasamy P, Thilagavathy K and Gunavathy K, "Numerical Methods", S.Chand& Co, Ramnagar, New Delhi, Reprint 2013.*

2. Veerarajan T and Ramachandran T, "Numerical Methods with Programming in C", Mcgraw Hill Education Pvt Ltd, New Delhi, Ist Edition, Reprint, 2016.

Reference Books:

1. Grewal B S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

2. Balagurusamy E, "Numerical Methods", Mcgraw Hill Education Pvt Ltd, New Delhi, I Edition Reprint, 2016.

3. Dr. Manish Goyal, "Statistics and Numerical Methods", University Science Press, New Delhi, 2010.

4. Dr. J.S. Chitode, "Numerical Methods", Technical Publications, Pune, 2010.

5. Ken F.Riley, Mike P.Hobson and Stephen J. Bence, "Fundamentals of Engineering Numerical Analysis", Cambridge University Press, New Delhi, 2015.

COURSE OUTCOME:

Upon completion of the course, the student will be able to

CO1: Understand the numerical solutions to algebraic, exponential, logarithmic, transcendental and linear system of simultaneous equations.

CO2: Acquire fluency in numerical interpolation techniques with equal and unequal intervals.

CO3: Understand the techniques of finite differences to apply for numerical differentiation, numerical quadrature and numerical cubature.

CO4: Understanding numerical solution to first order ordinary differential equations by different methods like single step and multistep etc,

CO5: Understanding numerical solution to second order partial differential equations by different methods using finite differences.

COURSE ARTICULATION MATRIX FOR 16CBS401 NUMERICAL METHODS

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L								M				M	H	L
CO2	H			H						H				L	M	L
CO3	H	M	M			L				H	M			L	M	L
CO4	H	H								H	H				L	L
CO5	H	H								H	H				L	L
16CES401	H	H	M	H		L				H	M			L	M	L

LL-Low, M-Moderate (Medium), H-High

16CES402 **MECHANICS OF SOLIDS - II** **Category: ES**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CES206 Engineering Mechanics**
2. **16CES303 Mechanics of Solids - I**

COURSE OBJECTIVES:

* To study the different methods of finding deflection of beam.
* To analyze the indeterminate beams and beam subject to unsymmetrical bending.
* To understand the concepts of deflection, stability criteria, theories of failure.
* To analyze the column with different end conditions and stress in thick cylinders.

UNIT I: DEFLECTION OF BEAMS AND TRUSSES (09)

Deflection Curve – Differential Equation – Double Integration Method – Macaulay's Method – Area Moment Method (Stepped Beams) – Conjugate Beam Method – Strain Energy and Dummy Unit Load Approaches – Castigliano's First and Second Theorems- Maxwells Reciprocal Theorem.Deflection of Trusses - Dummy Unit Load Method - Strain Energy Method - Williot Mohr's Diagram.

UNIT II: STATICALLY INDETERMINATE BEAMS (09)

Propped Cantilever Beams – Fixed Beams – Continuous Beams – Theorem of Three Moments – Calculation of Reactions, Bending Moments and Shear Force – Shear Force and Bending Moment Diagrams (For all types of loadings, couple).

Bending of Curved Bars:

Stresses in a Curved Bars – Winkler Bach Theory – Stresses in a Ring and Chain Link – Deflection of Curved Bars.

UNIT III: THEORY OF COLUMNS (09)

Members Subjected to Axial Load – Eccentric Load – Slenderness Ratio – End Conditions – Buckling Load For Columns- Euler's Theory – Assumptions and Limitations – Rankine - Gordon Formula – Combined Bending and Axial Load - Empirical Formula – Straight Line Formula – Columns Subjected to Eccentric Loading .

UNIT IV: UNSYMMETRICAL BENDING AND SHEAR CENTRE (09)

Unsymmetrical Bending – Product of Inertia – Stresses Due to Unsymmetrical Bending – Deflection of Beams Due to Unsymmetrical Bending – Shear Centre – Definition – Shear Centre for Symmetrical and Unsymmetrical Sections.

UNIT V: THICK CYLINDERS AND THEORIES OF ELASTIC FAILURE (09)

Lame's Equation – Hoop Stress and Radial Stress Distribution – Longitudinal Stress - Compound Cylinders – Wire Wound Cylinders – Shrink Fit.

Theories of Elastic Failure:

Theories of Elastic Failure – Factor of Safety – Graphical Representation of Theories for Two Dimensional Stress System.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2013.*
2. Vaidyanathan.R, Perumal.P and Lingeswari.S, "Mechanics of Solids and Structures, Volume I", Scitech Publications Pvt Ltd, Chennai, 2006.
3. Rajput.R.K, "Strength of Materials", S. Chand & Co., New Delhi, 2014.

Reference Books:

1. Prasad.I.B, "Strength of Materials", Khanna Publishers, New Delhi, 1998.
2. James .M. Gere "Mechanics of Materials", Thomson India, Brooks/Cole, 2006.
3. Kazimi, "Solid Mechanics", Tata Mcgraw Hill, 1998.
4. Punmia B C, Jain Ashok and Jain Arun. "Strength of Materials and Theory of Structures" – Vol.1, Laxmi Publications Pvt. Ltd., New Delhi, 2000.
5. Bansal R K "Strength of Materials", Laxmi Publications, New Delhi, 2010.

COURSE OUTCOME:

CO1: To impart knowledge on behaviour of structural elements subjected to transverse load.

CO2: To recognize the behaviour of statically indeterminate beams and curved bars.

CO3: To learn about the behavior of columns.

CO4: To develop the concepts of unsymmetrical bending of beams and shear centre.

CO5: To learn the theories of stress in thick cylinder and theory of elastic failures.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H			H			L	M			M			M	M	
CO2	M			M			L	H		M	M			M	H	
CO3	M			M			L	M			H			H	H	
CO4	H			H				M		H	M			M	M	
CO5	M			M				M		M	M			L	M	
16CES402	M			M			L	M		M	M			M	H	

L-Low, M-Moderate (Medium), H-High

16CES403 APPLIED HYDRAULICS AND FLUID MACHINES **Category: ES**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CBS1Z2 Engineering Mathematics - I**
2. **16CES206 Engineering Mechanics**
3. **16CES304 Mechanics of Fluids**

COURSE OBJECTIVES:

* To understand open channel hydraulics and to design most economical open channel sections with the knowledge of non uniform and critical flows.
* To apply impulse momentum principle for the design of hydraulic machinery.

UNIT I: OPEN CHANNEL FLOW (10)

Uniform Flow – Velocity Measurement – Manning's and Chezy's Formula – Roughness Coefficients – Normal Depth and Velocity – Most Economical Sections –Wide Open Channel – Specific Energy – Critical Flow and Its Computation- Dynamic Equations of Gradually Varied Flow – Assumptions – Characteristics of Flow Profiles – Draw Down and Back Water Curves – Hydraulic Jump – Types – Energy Dissipation

UNIT II: DIMENSIONAL ANALYSIS (06)

Dimensional Homogeneity-Rayleigh's and Buckingham Methods- Model Study and Similitude – Scale Effects and Distorted Model

UNIT III: MOMENTUM PRINCIPLE (10)

Impulse Momentum Principle- Impact of Jet – Force Exerted By a Jet on Normal, Inclined and Curved Surfaces for Stationary and Moving Vanes- Angular Momentum Principle- Inlet and Outlet Flow Diagrams

UNIT IV: TURBINES (10)

Turbines - Classification - Radial Flow Turbines - Axial Flow Turbines - Impulse and Reaction Turbines - Work Done and Efficiency - Draft Tube and Cavitation - Governing and Selection of Turbines - Operating Characteristic Curves of Turbines - Similarity Laws – Specific Speed - Run Away Speed

UNIT V: PUMPS (09)

Introduction to Modern Pumping Machinery - Centrifugal Pump - Work Done and Efficiency - Minimum Speed to Start the Pump - Npsh (Net Positive Suction Head) - Cavitation In Pumps - Multistage Pumps - Jet and Submersible Pumps - Positive Displacement Pumps - Reciprocating Pump - Work Done and Efficiency - Negative Slip - Flow Separation Conditions - Air Vessels - Indicator Diagram and Its Variation - Savings In Work Done - Rotary Pumps: Gear Pumps

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics, Including Hydraulic Machines", Standard Book House, Newdelhi, 2015*

2. Dr.D.S.Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K.Kataria & Sons, Newdelhi, 2009.

3. R.K.Bansal, "Fluid Mechanics and Hydraulic Machines", Lakshmi Publications, Newdelhi,2016

Reference Books:

1. Natarajan M.K, "Principles of Fluid Mechanics", Anuradha Agencies, Vidayal Karuppur, Kumbakonam,1995.

2. Subramanya K.,"Flow In Open Channels",Tata Mcgraw-Hill Publishing Company, 2015.

3. S.Ramamurtham and R.Narayanan, "Hydraulics Fluid Mechanics and Fluid Machines" Dhanpat Rai Publishing Company (P) Limited, 2006.

4. R.K.Rajput, "A Text Book of Fluid Mechanics", S.Chand and Company, New Delhi,2016.

5. D.Ramadurgaiah, "Fluid Mechanics and Machinery", New Age International (P) Ltd., 2002.

COURSE OUTCOME:

CO1: Gain insight knowledge on open channel hydraulics and to solve practical problems.
CO2: Understand the concepts of dimensional analysis for fluid flow problems.
CO3: Apply the momentum principle for the determination of hydrodynamic forces.
CO4: Aquire knowledge in selection and design of turbines based on head and discharge requirements.
CO5: Capable of estimating pump efficiency for different operating conditions.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M		H			M	M		M	H	H	L	H	H	H
CO2	H	M		H			M	M		M	H	H	L	H	H	H
CO3	H	M		H			H		M		M	H	L	H	M	H
CO4	H	H		H			M	M		M	M	H	L	H	H	M
CO5	H	M		H			H		M		M	H	L	H	M	H
16CES 403	H	M		H			M	M	M	M	M	H	L	H	H	H

L-Low, M-Moderate (Medium), H-High

16CPC404 **BASIC STRUCTURAL DESIGN – I (MASONRY AND STEEL)** **Category: PC**

L	T	P	C
3	2	0	4

PRE-REQUISITES:

1. **16CES206 Engineering Mechanics**
2. **16CES303 Mechanics of Solids - I**

COURSE OBJECTIVES:

* To study the behaviour and design of various structural elements made of masonry.
* To design the tension and compression steel elements and their connections.
* To understand the behaviour of flexural members and to design laterally restrained and unrestrained beams.

UNIT I: MASONRY (9+6)

Mix Proportions – Compressive Strength of Mortars – Basic Compressive Stress – Design of Masonry Walls – Eccentrically Loaded Walls – Shape Factor For Masonry Units – Stability of Walls – Design of Walls and Piers.

UNIT II: SIMPLE STEEL CONNECTIONS (9+6)

Steel Standard Sections – Properties – Introduction to Limit State Design.

Bolted Connections: Types of Bolts – Permissible Stresses For Black Bolt, Hsfg Bolts– Design of a Bolt in Single Shear, Double Shear and Bearing.

Welded Connections: Principle of Welding – Weld Symbols – Types of Welded Joints – Strength of Fillet and Butt Weld – Design of Welded Connections for Lap and Butt Joint – Detailing of Weld.

UNIT III: ECCENTRIC CONNECTIONS AND TENSION MEMBER (9+6)

Eccentric Connections: Bracket Connection Type I and Type II.

Tension Members: Design of Simple and Built Up Members Subjected to Tension – Effective Area of Angle and Tee Sections Connected to Gussets –Tension Splice – Lug Angle.

UNIT IV: COMPRESSION MEMBERS (9+6)

Axially Loaded Columns – Effective Length of Compression Members – Plastic Analysis – Slenderness Ratio –Strength of Compression Members – Design of Columns – Built Up Columns – Design of Lattices and Battens – Design of Slab Base – Gusseted Base.

UNIT V: BEAMS (9+6)

Introduction to Plastic Analysis - Beams - Permissible Bending Stress - Section Classification– Design of Laterally Supported and Unsupported Simply Supported Beams – Design of Built Up Beams – Curtailment of Flange Plate – Connection Between Flange Plate and Beam – Need for Lateral Support of Compression Flange and Design – Strength of Beams In Shear.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

Text Books:

1. *Anand S. Arya, "Structural Design In Steel, Masonry and Timber", Nemchand & Bros., Roorkee, 1993.*
2. *Duggal.S.K, "Limit State Design of Steel Structures", Mcgraw Hill Education India (P) Ltd , New Delhi, 2014.*
3. *Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2011.*

Reference Books:

1. *Is: 1905 – 1987, Code of Practice For Structural Use of Unreinforced Masonry.*
2. *Is: 800 – 2007, General Construction In Steel — Code of Practice.*
3. *Is: Sp 6(I) – 1964, Handbook for Structural Engineers.*
4. *Gambhir M.L. "Fundamentals of Structural Steel Design", Mcgraw Hill Publications Pvt. Ltd, 2013.*
5. *Ramachandra, " Design of Steel Structures", Vol. I & II, Standard Publishing House, New Delhi, 2009.*
6. *B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Design of Steel Structures, Vol. I & II", Laxmi Publications (P) Ltd, 1998.*
7. *P. Dayaratnam, "Brick and Reinforced Brick Structures", Oxford and Ibh Publishing House, 1997.*

COURSE OUTCOME:

CO1: Able to apply the basic requirements of indian standards for analysis and design of masonry structures.

CO2: Able to identify the different failure modes of bolted and welded connections and design connections subjected to axial load.

CO3: Able to analyze and design the eccentric connections and tension members.

CO4: Able to design compression members and bases.

CO5: Able to design laterally supported and unsupported beams.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	**H**			**H**							**H**		**H**	**H**	**M**	
CO2	**H**			**H**							**H**		**H**	**H**	**M**	
CO3	**H**			**H**							**H**		**H**	**H**	**M**	
CO4	**H**			**H**							**H**		**H**	**H**	**M**	
CO5	**H**			**H**	**H**		**M**				**H**		**H**	**H**	**M**	
16CPC404	**H**			**H**	**H**		**M**				**H**		**H**	**H**	**M**	

L-Low, M-Moderate (Medium), H-High

16CPC405 **SURVEYING – II** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC305 Surveying – I

COURSE OBJECTIVES:

- To learn about the advanced methods of surveying to solve complex civil engineering problems.
- To understand the principles and concepts of advanced surveying instruments.
- To learn about errors in field measurements and their adjustments.
- To understand the setting out of horizontal and vertical curve.

UNIT I: TACHEOMETRIC SURVEYING (09)

Tacheometric Systems-Tangential**,** Stadia and Subtence Methods-Stadia Systems- Fixed and Movable Hairs-Stadia Constants - Horizontal and Inclined Line of Sights-Vertical and Normal Staffing- Tangential Tacheometry - Anallactic Lens –Subtence Bar.

UNIT II: CONTROL SURVEYING (09)

Vertical and Horizontal Control-Triangulation-Classification – Intervisibility - Triangulation Figures – Strength of Figure - Signals and Towers - Base Line Measurements - Satellite Stations and Reduction to Centre - Trignometric Leveling – Geodetic Observations – Difference in Elevation - Single and Reciprocal Observations.

UNIT III: SURVEY ADJUSTMENTS (09)

Definitions - Errors- Types - Sources, Precautions and Corrections- True and Most Probable Values- Laws of Weights - Principle of Least Squares- Determination of Most Probable Values - Normal Equations Method – Method of Differences - Method of Correlates – Adjustment of Plane and Spherical Triangle.

UNIT IV: HYDROGRAPHIC SURVEYING (09)

Shore Line Survey – Tides – Tide Gauges – Types – Sounding – Equipments – Locating Sounding - Reduction- Route Survey – Reconnaissance, Preliminary, Location and Construction Survey.

UNIT V: MODERN SURVEYING INSTRUMENTS (09)

Digital Level - Electromagnetic Distance Measurement - Electromagnetic Waves – Principle – Types of Edm Instruments – Total Station – Parts – Accessories – Field Procedure – Errors – Office Work – GPS – Development – Basic Concepts – Segments - Receivers and Methods - Applications – GIS – Components - Data Models – Data Acquisition – Maps and Map Projection.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *Kanetkar .T.P, and Kulkarni .S.V, "Surveying and Levelling, Vol. I & II", Pune Vidyarthi Griha Prakashan 2004.*

2. Bhavikatti S.S., "Surveying and Levelling , Vol.II", I.K. International Publishing House Pvt. Ltd., 2011.

Reference Books:

1 .Punmia B.C , "Surveying" , Vol. I &II , Laxmi Publication , 2007.
2 .Bannister . A &Reynolds .S , "Surveying" , Prentice Hall, 1998.
3 .Chandra A.M., " Higher Surveying", New Age International Pvt. Ltd, 2007.

COURSE OUTCOME:

CO1: The students will possess knowledge about tachometric surveying and control surveying.

CO2: Able to do survey adjustments in the field measurements.

CO3: The student will be able to interpret survey data and calculate surveying quantities.

CO4: The student will be able to know about hydrographic surveying.

CO5: The student will gain knowledge on modern surveying instruments.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1			**L**	**M**						**L**						
CO2	**H**			**L**											**L**	
CO3				**M**						**L**				**M**		
CO4	**M**		**L**								**M**					**L**
CO5	**L**									**M**				**M**		
16CPC405	**H**		**L**	**M**						**L**	**M**			**M**	**L**	**L**

L-Low, M-Moderate (Medium), H-High

16CPC406 **WATER SUPPLY ENGINEERING** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

- To make the students conversant with sources and its demand of water.
- To understand the basic characteristics of water and conveyance of water.
- To expose the students to understand the design of water treatment.
- To provide adequate knowledge about the advanced water treatment processes.
- To have adequate knowledge on distribution of water supply.

UNIT I: QUANTITY OF WATER AND SOURCES OF WATER (09)

Public Water Supply System – Planning, Objectives, Design Period, Population Forecasting; Water Demand – Sources of Water and Their Characteristics, Surface and Groundwater – Impounding Reservoir – Development and Selection of Source – Source Water Quality.

UNIT II: QUALITY OF WATER AND TRANSPORTATION (09)

Quality of Water - Sampling - Characterization – Significance -Analysis of Water - Water Borne Diseases - Quality Standards of Water. Intakes - Types - Intake Tower - Transportation of Water - Types of Conduits -Hydraulics of Pipe Flow - Design - Materials of Pressure Pipes - Pipe Corrosion - Theories, Effect and Prevention- Laying and Testing of Pipe Lines. Pumps - Types of Pumps - Selection of Pumps - Pumping Stations.

UNIT III: WATER TREATMENT (09)

Objectives – Unit Operations and Processes – Principles, Functions, and Design of Water Treatment Plant Units, Aerators, Flash Mixers, Coagulation and Flocculation – Clarifloccuator - Plate and Tube Settlers - Pulsator Clarifier - Sand Filters - Disinfection - Residue Management – Construction, Operation and Maintenance Aspects.

UNIT IV: ADVANCED WATER TREATMENT (09)

Water Softening - Desalination - R.O. Plant - Demineralization – Adsorption - Ion Exchange - Membrane Systems - Ro Reject Management - Iron and Manganese Removal - Defluoridation - Construction and Operation & Maintenance Aspects – Recent Advances.

UNIT V: DISTRIBUTION OF WATER AND OF WATER SUPPLY (09)

Distribution of Water - Requirements of Good Distribution System - Method of Distribution System - Layouts of Distribution System - Requirements of Water Distribution – Components – Selection of Pipe Material – Service Reservoirs – Functions – Network Design – Economics – Analysis of Distribution Networks -Computer Applications – Appurtenances – Leak Detection. Principles of Design of Water Supply in Buildings – House Service Connection – Fixtures and Fittings, Systems of Plumbing and Types of Plumbing.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *Garg. S. K., "Water Supply Engineering", Khannah Publishers, Delhi, September 2001.*
2. Mark J. Hammer, Mark J. Hammer Jr, "Water and Waste Water Technology", Prentice Hall of India 2008.
3. S. C. Rangwala and K. S. Rangwala, "Water Supply and Sanitary Engineering", Charotar Publishing House 2012.

Reference Books:

1. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and Sons, 2010.

2. Fair. G. M..,Geyer. J. C., "Water Supply and Waste Water Disposal", John Wiley & Sons, 3rd Edition, 2011.

3. Duggal. K.N., " Elememts of Public Health Engineering", S.Chand and Co,1985. Jain Publishers, Cpheeco Manual

4. Metcalf & Eddy, "Water Reuse", Mcgraw Hill Education, Europe, 2007.

COURSE OUTCOME:

CO1: Able to understand the principles of water supply and characteristics of water.

CO2: Able to attain knowledge on quality of water and its conveyance.

CO3: Able design various water treatment units.

CO4: Able to get clear knowledge about advanced water treatments

CO5: Able to understand the distribution and supply of water

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	**M**											**L**	**L**	**M**	**L**	
CO2	**M**	**L**										**L**	**M**	**M**	**L**	
CO3	**M**		**H**									**L**	**M**	**M**	**M**	
CO4	**L**				**M**							**L**	**M**	**M**	**M**	
CO5	**L**				**M**							**L**	**M**	**M**	**L**	**M**
16CPC406	**M**	**L**	**H**		**M**							**L**	**M**	**M**	**L**	**M**

L-Low, M-Moderate (Medium), H-High

16CPC407 **SURVEY PRACTICAL – II** **Category: PC**

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1.16CPC307 – Survey Practical – I

COURSE OBJECTIVES:

* To understand the advanced surveying techniques.
* To enable the handling of advanced surveying equipments.
* To apply suitable surveying methods and instruments for a given problem.

LIST OF EXPERIMENTS

1. Measurement of Horizontal Angles by Repetition and Reiteration Methods.
2. Theodolite Traversing.
3. Theodolite Survey – Inaccessible Horizontal Distance.
4. Single Plane Method.
5. Double Plane Method.
6. Determination of Stadia Constants.
7. Stadia Tacheometry.
8. Tangential Tacheometry.
9. Subtense Bar Method.
10. Setting Out Simple Curve – Offset From Long Chord and Instrumental Methods.
11. Area of Polygon by Total Station.

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: The student will be able to conduct field survey by tacheometer.

CO2: The student will be able to do measurements precisely using advanced surveying instruments.

CO3: The student will be able to solve complex surveying problems.

CO4: The student will be able to set out curves.

CO5: The student will be able to handle the advanced surveying instruments like total station and gps.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M							L							
CO2				L						M						L
CO3	L									M	L					
CO4		L								M				L		
CO5		L		L					M							
16CPC407	L	L		L					M	M	L			L		L

L-Low, M-Moderate (Medium), H-High

16CES408 FLUID MECHANICS AND MACHINERY LABORATORY

Category: ES

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16CES304 Mechanics of Fluids

COURSE OBJECTIVES:

* Students should be able to verify the principles which are studied in theory subjects by performing the various experiments in the laboratory.

LIST OF EXPERIMENTS

1. Determination of Major and Minor Losses in Pipes
2. Verification of Bernoulli's Theorem
3. Calibration of Venturimeter and Orificemeter
4. Flow Over Rectangular and V- Notches
5. Flow Through Mouthpiece / Orifice
6. Determination of Velocity Through Pitot Tube
7. Calibration of Pressure Gauges
8. Determination of Meta Centric Height
9. Performance Study of Rotodynamic Pumps: Centrifugal Pump, Submersible Pump , Vertical Turbine Pump and Jet Pump
10. Performance Study of Positive Displacement Pumps: Reciprocating Pump, Gear Oil Pump and Single Screw Pump.
11. Load Test on Pelton Wheel, Francis Turbine and Kaplan Turbines.

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: The students would obtain the knowledge on conducting different experiments.

CO2: The students are able to solve problems in pipe due to major and minor losses.

CO3: The students are able to verify the bernoulli's theorem and their applications.

CO4: The students are able to do performance tests on different types of pumps.

CO5: The students are able to do performance tests on different types of turbines.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	L	M				L	H	M	M	L		H	M	L
CO2	L	H	M	H			L		M	L		L		M	H	M
CO3	M	H	L	M			L							H	H	L
CO4	L		M	H	L				M	L	L			M	H	L
CO5	M	H	L	M			L							H	M	L
16CES408	M	H	L	M	L		L	L	M	L	L	L		H	H	L

L-Low, M-Moderate (Medium), H-High

16CPC501 **STRUCTURAL ANALYSIS - I** **Category: PC**

L	T	P	C
3	2	0	4

PRE-REQUISITES:

1. 16CES303 Mechanics of Solids - I
2. 16CES402 Mechanics of Solids - II

COURSE OBJECTIVES:

* To impart knowledge on basic concepts to analyse different kind of structures

UNIT – I : FUNDAMENTAL CONCEPTS AND ENERGY METHODS (9+6)

Definition and Determination of Static and Kinematic Indeterminacy – Beams, Trusses and Frames –Equilibrium and Kinematic Stability – Basic Methods of Structural Analysis– Energy principles – Strain energy and Complementary Energy - Principle of Stationary Potential Energy – Principle of Virtual Displacements — Principle of virtual Forces – Castigliano's First and Second Theorem – Theorem of least work – Clark Maxwell's reciprocal theorem – Betti's theorem – Application to simple problems of statically determinate beams, trusses and frames.

UNIT – II : ROLLING LOADS AND INFLUENCE LINES ON BEAMS (9+6)

Determinate Beams: Rolling loads - Single concentrated load– UDL longer than the span – UDL shorter than the span– Two concentrated loads – Series of concentrated loads – Equivalent UDL
Influence lines - reactions, shear force, bending moment, absolute maximum shear force and absolute maximum bending moment for all types of loads.
Indeterminate beams: Muller Breslau's principle - influence lines for continuous beams.

UNIT – III : ARCHES (9+6)

Three hinged arch – Two hinged arch – symmetrical and unsymmetrical - parabolic and circular arches under concentrated loads and uniformly distributed loads –Reaction, Normal Thrust, Radial shear and Bending Moment – Temperature effects – Rib shortening.

UNIT – IV : INFLUENCE LINES FOR ARCHES AND PLANE FRAMES (9+6)

Symmetrical arches - Influence lines for horizontal thrust, bending moment, radial shear and normal thrust for parabolic arch – single rolling load and uniformly distributed load – Unsymmetrical arches - Influence lines for horizontal thrust.
N type truss – Pratt truss with parallel chords and inclined chords - Warren truss with parallel chords and inclined chords.

UNIT – V : CABLES AND SUSPENSION BRIDGES (9+6)

Components and their Functions - Shape of cable under self weight - Anchorage of suspension cables - Analysis of cable under concentrated loads and UDL – Three hinged and Two hinged stiffening girders – Shear force and Bending Moment due to concentrated loads and UDL - Influence lines for Shear Force and Bending Moment

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

1. *Reddy C.S., "Basic Structural Analysis", Tata McGraw Hill Publishing Co., 2015.*
2. Punmia B.C, "Strength of Materials and Mechanics of Structures, Vol. II",Standard publishers, 2008.
3. Vaidayanathan.R and Perumal.P, "Comprehensive Structural Analysis, Vol.I and II", Laxmi publications, 2008.

Reference Books:

1. Timoshenko S.P and Young D.H., "Theory of Structures", McGraw – Hill Book Company, New Delhi 1965.
2. Sterling Kinney. J "Indeterminate Structural Analysis", Narasa Publishing House, Delhi, 1987.
3. Negi L.S and Jangid R.S., "Structural Analysis", Tata McGraw - Hill Publishing Company, New Delhi, 2003.
4. Ramamurtham. S "Theory of structures", Dhanpat Rai & Sons, New Delhi, 2004.

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Find redundant in the structures like beams, trusses and frames using energy methods

CO2: Analyse the simply supported beams with rolling loads.

CO3: Analyse three and two hinged arches,

CO4: Construct the influence lines for beams, frames, trusses, arches and stiffening girders.

CO5: Solve the problems on cables and suspension bridges

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M													L		
CO2	L													M		
CO3		L		M											H	
CO4	M													H		
CO5		L		M												
16CPC501	M	L		M										H	H	

L-Low, M-Moderate (Medium), H-High

16CPC502 BASIC STRUCTURAL DESIGN - II (CONCRETE) Category: PC

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 16CPC404 Basic Structural Design - I
2. 16CES303 Mechanics of Solids - I
3. 16CES402 Mechanics of Solids - II

COURSE OBJECTIVES:

* To know the design philosophies of concrete structures.
* To understand the limit state design of slabs and beams and to know the behaviour of RC beams in shear and torsion.
* To get the concepts of limit state design of columns and to understand the limit state design of footings.

UNIT – I : REINFORCED CONCRETE MATERIALS (09)

Stress strain curve for concrete – Standard concrete mixes for RCC works – types of Reinforcements – plain and deformed bars – Stress – strain curve for reinforcing steel - Design philosophy – Basic design concepts – working stress, ultimate load and limit state methods - Characteristic load and strength – permissible stresses – partial safety factors – limit state of collapse– limit state of Serviceability – Durability limit state – deflection and cracking – modification factors.

UNIT – II : LIMIT STATE DESIGN OF BEAMS (09)

Analysis and design of singly and doubly reinforced rectangular and flanged beams - Design of sections subjected to the combined action of bending moment, transverse shear and torsion.

UNIT - III : LIMIT STATE DESIGN OF SLABS (09)

Behaviour of one way and two way slabs – Analysis, design and detailing of one way and two way rectangular slabs subjected to uniformly distributed load - Design of lintel and lintel cum sunshade – Design of stair case.

UNIT - IV : LIMIT STATE DESIGN OF COLUMNS (09)

Types of columns – Design of rectangular and circular columns for axial load – Design of short columns subjected to axial load and uniaxial / biaxial bending - Interaction charts.

UNIT – V : LIMIT STATE DESIGN OF FOOTINGS (09)

Design of wall footing – strip foundation to wall under axial load, eccentric load – Design of isolated footing for axially loaded columns.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Pillai, S. U. and Menon, D, "Reinforced Concrete Design", Tata McGraw Hill, 2003.*
2. *Shah V.L and Karve S.R, "Limit State Theory and Design of Reinforced Concrete", Structures Publications, 2014.*
3. *Varghese P.C, "Limit State Design of Reinforced Concrete", Prentice hall of India Pvt. Ltd., 2008.*

Reference Books:

1. *IS: 456 – 2000, Indian Standard code of practice for Plain and Reinforced concrete.*
2. *Dayaratnam P.,"Design of Reinforced Concrete Structures", Oxford & IBH publishing Co.Pvt.Ltd.,2003.*
3. *N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, 2014.*
4. *Ashok K. Jain, "Reinforced Concrete – Limit State Design" – Nem Chand & Bros., 2003.*
5. *Sinha.S.N, "Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd., 2005.*

COURSE OUTCOME:

CO1: Able to understand the concepts of working stress and limit state methods.

CO2: Able to design singly and doubly reinforced rectangular beam, flanged beam for flexure, shear and torsion.

CO3: Able to design and detail one way and two way rectangular slabs by limit state method.

CO4: Able to design the columns subjected to both axial and eccentric loads and understand the use of interaction diagrams.

CO5: Able to design axially and eccentrically loaded wall and isolated footings.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		L	H	M			M			M		M	H	M	
CO2	H	M		H				M					M	H	M	
CO3	H	M		H				M					M	H	M	
CO4	H	M		H				M					M	H	M	
CO5	H	M		H				M					M	H	M	
16CPC502	H	M	L	H	M			M			M		M	H	M	

L-Low, M-Moderate (Medium), H-High

16CPC503 WATER RESOURCES ENGINEERING Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CPC406 Water Supply Engineering**

COURSE OBJECTIVES:

- The student is exposed to know the hydrological cycle in earth system, importance of reservoir planning and design of well in different aquifers.
- The student is understood the design of canals, distribution of water and river control.

UNIT - I: SURFACE WATER HYDROLOGY (09)

Hydrological Cycle – Precipitation – forms and types – Average rainfall over a basin - Arithmetic mean, Thiessen polygon and Isohyetal method - missing precipitation – optimum numbers. Runoff process - Estimation of Surface Runoff - Empirical formulae, Infiltration Indices and Unit Hydrograph method – Flood estimation by Empirical formulae - Rational formula – Recurrence interval – Importance of rainwater harvesting.

UNIT – II: RESERVOIR PLANNING (09)

Purpose of storage work – types of reservoirs – Investigation for reservoir planning – Selection of site for a reservoir –Yield of a reservoir – Safe, secondary and average yield – mass curve and demand curve - Calculation of safe yield from a reservoir of a given capacity- Determination of reservoir capacity for a specified yield – Zones of storage in reservoirs – Reservoir sedimentation and their control – trap efficiency - Basics of flood routing.

UNIT – III: GROUND WATER HYDROLOGY (09)

Occurrence of ground water – types of aquifers – Storage coefficient – coefficient of transmissibility and permeability – types of open and tube wells. Steady radial flow into a well - Yield estimation of unconfined and confined aquifers – Yield from an open well by constant level pumping test and recuperation test – well loss - Site selection for a tube well – Problems.

UNIT – IV: DISTRIBUTION SYSTEM (09)

Classification of Canals – canal alignment – Design procedure for an unlined irrigation channel - Kennedy's theory –Wood table – Lacey's theory – Comparisons of the two theories – Uses of Garret's diagram in channel design – Balancing depth of cutting – component parts of a canal cross section – design of lined canals – Problems.

UNIT – V: WATER LOGGING, DRAINAGE AND RIVER CONTROL (09)

Water logging – Causes and effects of water logging – Remedial measures – Land Drainage – Advantages – Types of drainage system – layout of tile drainage. Rivers – classifications – Meandering and cut-off – River training works - Objectives – Classification and Types of river training works.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Punmia .B.C. and Pande B. B.Lal, "Irrigation and Water Power Engineering", Laxmi Publications Pvt.Ltd, New Delhi, 2009.*
2. Santosh Kumar Garg, "Irrigation Engineering and Hydraulics Structures", Khanna Publications Pvt.Ltd, New Delhi, 2009.

Reference Books:

1. Duggal .K.N and Soni. J.P, "Elements of Water Resources Engineering", New Age International Pvt.Ltd, NewDelhi, 2005.
2. Gupta. B. L and Amit Gupta, "Water resources System and Management", Standard Publishers Distributors, New Delhi, 2007.

COURSE OUTCOME:

CO1: The students would be able to explain the hydrological cycle and its components.

CO2: The students are able to fix the reservoir capacity and their yield predictions.

CO3: The students would be able to do the yield tests in open and tube wells in real fields.

CO4: The students can able to design the section of lined and unlined channels.

CO5: The students are able to identify the remedy for water logging and river control works.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M		L		L			H		L	L		H	M	L
CO2	L	M		M			L	H	L					M	L	
CO3	L	H		H	L		H		L	M			L	H	M	L
CO4	L							M	M	H	L		M	H	L	M
CO5	M	M	L	L		L	L			L	M	M		M	M	L
16CPC 503	L	M	L	H	L	L	L	H	L	H	L	M	M	H	M	L

L-Low, M-Moderate (Medium), H-High

16CPC504 CONCRETE TECHNOLOGY Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CES105 Materials In Construction

COURSE OBJECTIVES:

* To learn the tests to be carried out on various concrete making materials as per IS codal provisions and to understand their properties.
* To study the properties of fresh and hardened concrete.
* To know about various methods of mix design for concrete.
* To have an exposure on various special concretes.

UNIT – I : INGREDIENTS OF CONCRETE (09)

Cement – constituents- Hydration – Tests on cement – Types of cement – Aggregates – properties and uses – Classification of aggregates – Properties and test on aggregates – gradation – Quality of water – Admixtures – Chemical Admixtures and mineral admixtures.

UNIT – II : FORMWORK AND PRODUCTION OF CONCRETE (09)

Requirements of formwork – Economy in formwork – Materials for forms – Arrangement of forms for slabs, beam, column, walls, culverts, stairs etc – Removal of forms – Design considerations. Measurement of materials – batching – Mixing –Transportation – Placing of concrete in cold weather, hot weather and under water concreting – Compaction – Curing.

UNIT - III : PROPERTIES OF CONCRETE (09)

Properties of fresh concrete – Workability – Segregation – Bleeding – Test for fresh concrete properties - Properties of hardened concrete – Strength – Stress - Strain characteristics – Modulus of Elasticity – Shrinkage – Creep – Thermal properties – Permeability – Test for hardened concrete properties – Test for micro structural properties of concrete - Non-Destructive Test.

UNIT - IV : CONCRETE MIX DESIGN AND QUALITY CONTROL OF CONCRETE (09)

Quality Control - Frequency of sampling – Statistical analysis of test results – standard deviation – Coefficient of variation – Characteristic strength – Acceptance and rejection Criteria – Importance of water cement ratio – Importance of cover to concrete. Nominal mixes – Design Mixes – factors influencing the design mix – Mix Design by ACI method, IS method and DOE method.

UNIT – V : SPECIAL CONCRETES (09)

High Strength concrete - High Performance Concrete - reactive powder concrete - Light weight, heavy weight and mass concrete – Self Compacting Concrete – Self Curing Concrete – Polymer Concrete – Fibre Reinforced Concrete - Ready Mixed Concrete – Geo polymer concrete.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Shetty M.S, "Concrete Technology", S.Chand & Company, New Delhi, 2006.*
2. *Santhakumar A.R, "Concrete Technology", Oxford university press, 2006.*
3. *Gambhir M.L, "Concrete Technology", Tata Mc-Graw Hill Company, 2013.*

Reference Books:

1. *IS 10262 – 2009, Concrete Mix Proportioning – Guidelines.*
2. *ACI 211, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete, American Concrete Institute.*
3. *Orchard D.F., "Concrete Technology", Vol I & II , 1998.*
4. *Neville A.M "Properties of Concrete", Pearson Education, 2010.*
5. *Povindar K. Mehta, Paulo J. M. Monteiro, "Concrete: Microstructure, Properties, and Materials", Mc-GrawHill Company, 2011.*

COURSE OUTCOME:

CO1: Able to produce better quality concrete by understanding the properties of concrete and the role of ingredients like cement, aggregate, admixtures in concrete.

CO2: Able to design the formwork.

CO3: Able to produce concrete with adequate workability, strength and durability.

CO4: Able to proportion the concrete using various mix design concepts.

CO5: Able to select appropriate type of concrete for specific requirements.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		M				M		M		M	M	H	L		
CO2	M				M		M	L	M	M	M		H	L	M	
CO3	M		M	H			M		M		M		H	L		
CO4	M	M		H	M		M	L	M	M	M		H	L	M	
CO5	M					L	M		M		M	H	H	L		M
16CPC504	M	M	M	H	M	L	M	L	M	M	M	H	H	L	M	M

L-Low, M-Moderate (Medium), H-High

16CPC505 **MECHANICS OF SOILS** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CBS1Z2 Engineering Mathematics - I
2. 16CES304 Mechanics of Fluids

COURSE OBJECTIVES:

∗ To impart knowledge on engineering behaviour and performance of soil. At the end of this course student attains adequate knowledge in assessing the physical, engineering, compaction and strength properties of soils.

UNIT - I : BASIC PROPERTIES OF SOILS (09)

Soil formation – Soil problems in Engineering – Physical properties of soil – Phase relations – Index properties of soil –Grain size distribution – Atterberg's limits – Soil classification system – their significance – Field identification – Simple tests.

UNIT – II : STRESSES IN SOILS (09)

Soil water statics – Concept of effective and neutral stresses – Capillary phenomenon – Vertical stress distribution in soils – Boussinesq's equation – Line load – Uniformly distributed loads – New marks chart – Construction and use –Approximate methods – Pressure bulb – Westergaard's equation.

UNIT - III : PERMEABILITY AND SEEPAGE (09)

One dimensional flow through soil – permeability – Darcy's law – Laboratory and field methods – Factors influencing permeability – Flow through stratified soil – Seepage pressure – Quick sand condition – Soil liquefaction – Two dimensional flow – Laplace equation – Electrical analogy – Flow net –Methods of construction – Properties – Applications – Sheet pile cut off and earth dam – Phreatic line.

UNIT - IV : COMPACTION AND CONSOLIDATION (09)

Compaction – Laboratory test – Standard proctor's compaction – Modified proctor's compaction – Factors affecting compaction – Field compaction methods – Compaction control. Consolidation – Consolidation settlement – Laboratory test – Determination of Cv by curve fitting methods – Terzaghi's one dimensional consolidation – Maximum past stress, OCR – Field curve – Pre consolidation pressure – e vs p curve – Boundary condition – Time factor – Time rate of consolidation.

UNIT – V : SHEAR STRENGTH (09)

Shear strength of soil – Mohr-Coulomb's strength criterion – Factors affecting shear strength – Laboratory test – Direct shear – Triaxial compression – Drainage conditions – UCC – Vane shear – Cyclic loading – Skempton's pore pressure coefficients.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *GopalRajan and Rao, A.S.R.,"Basic and Applied Soil Mechanics", New Age International Publishers, Third Edition, New Delhi, 2006.*
2. *Palanikumar, M.,"Soil Mechanics", PHI Learning Pvt. Ltd., 2013.*
3. *Murthy, V.N.S.,"Principles of Soil Mechanics and Foundation Engineering", Fifth revised edition, UBS Publishers' Distributors Ltd., New Delhi, 2001.*

Reference Books:

1. Venkataramaiah. C, "Geotechnical Engineering" Revised Third Edition, New Age International (P) Ltd. Publishers, New Delhi, 2006.
2. Coduto D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt.Ltd.,New Delhi, 2002.
3. T. William Lambe and Robert V. Whitman, "Soil Mechanics", John Wiley and Sons, 1969.

COURSE OUTCOME:

CO1: The student acquires the capacity to assess the physical, engineering properties of soil and Classify the soil.

CO2: The student gets an idea about the soil water system and stress distribution in soils.

CO3: The student acquires the knowledge on the permeability and seepage through soils.

CO4: The students obtain adequate knowledge on the compaction and consolidation characteristics of soils.

CO5: Students are able to find out the shear strength of soils.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M							H		H		H	H	L	
CO2		H		M					M	L	H		M	H	M	
CO3	M	H					H		H	L	H		M	H	H	
CO4		H							H	H	H		M	H	H	
CO5		H							H		H		M	H	H	
16CPC 505	H	H		M			H		H	L	H		M	H	H	

L-Low, M-Moderate (Medium), H-High

16CPC506 WASTEWATER ENGINEERING Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CPC406 Water Supply Engineering**

COURSE OBJECTIVES:

- To learn the basics of sewage composition and its characteristics.
- To give information about Sewer and its design.
- To depict the information about various sewage treatment processes.
- To provide the adequate information on various disposal methods.

UNIT - I : QUANTITY AND HOUSE DRAINAGE (09)

Necessity and objectives of sanitary engineering projects - Definitions - systems of sewerage - quantity of sewage -Fluctuations in flow pattern - Estimation of storm runoff - DWF and WWF - Design flow for separate and combined systems - House drainage - Sanitary fixtures / fittings - one pipe system, two pipe system, etc. -General layout of house drainage - street connections.

UNIT – II : SEWER AND SEWER APPURTENANCES (09)

Hydraulics of sewers - Self cleansing velocities - full flow / partial flow conditions - sewer sections – sewer appurtenances - Design principles and procedures - materials for sewers - sewer joints - sewer laying –sewer cleaning and maintenance - sewage pumping - types of pumps.

UNIT – III : QUALITY OF SEWAGE AND PRIMARY TREATMENT (09)

Characteristics and composition of sewage - physical and chemical analysis - DO, BOD,COD and their Significance - cycles of decomposition - Objectives and basic principles of sewage treatment - primary treatment- screens - Grit chamber - settling tank - principles of sedimentations - Design of settling tanks.

UNIT - IV : BIOLOGICAL TREATMENT OF SEWAGE (09)

Basic principles of biological treatment - Filtration - contact beds - Sand Filters - trickling filters - Description and principles of operation of standards / high rate filters - recirculation - activated sludge process - diffuser /Mechanical aeration - Conventional, high rate and extended aeration process - oxidation pond - stabilization ponds - aerated lagoons - Septic tanks and effluent disposal system.

UNIT – V : SEWAGE DISPOSAL AND SLUDGE MANAGEMENT (09)

Objectives of sludge treatment - properties and characteristics of sludge - Thickening - sludge digestion - drying beds - conditioning and dewatering - sludge disposal - Eutrophication - recycle & reuse of waste effluents –elutriation - Methods - dilution method – self-purification of streams - oxygen sag curve - land disposal –sewage farming.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Hussain. S. K., "Text Book of Water Supply and Sanitary Engineering", Oxford and IBH Publishing.*
2. Mark J. Hammer, Mark J. Hammer Jr,"Water and Waste Water Technology", Prentice hall of India 2008.
3. S. C. Rangwala and K. S. Rangwala, "Water Supply and Sanitary Engineering", Charotar Publishing house 2012

Reference Books:

1. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 1985.
2. Fair. G. M..,Geyer. J. C., "Water Supply and Waste Water disposal", John Wiley & Sons,1954.
3. Babbit. H. E., and Donald. J. J., "Water Supply Engineering", McGraw Hill book Co, 1984
4. Steel E. W. et.al, "Water Supply Engineering", McGraw Hill International Book Co,1984
5. Duggal. K.N., "Elements of public Health Engineering", S.Chand and Co,1985. Jain Publishers, CPHEECO MANUAL

COURSE OUTCOME:

CO1: Able to attain knowledge on sewage production and house drainage.

CO2: Able to understand Sewerage systems and its design.

CO3: Able to analyse the quality of sewage and design of primary treatments of sewage.

CO4: Able to understand and design the biological treatments of sewage.

CO5: Able to understand the objectives of sludge treatment and disposal.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M											L	M	L	L	L
CO2	M			L								L	M	M	M	L
CO3	M									M		L	M	M	M	L
CO4	L								L	H		L	M	M	H	L
CO5	L								M				M	L	L	M
16CPC 506	M			L					M	H		L	M	M	H	L

L-Low, M-Moderate (Medium), H-High

16CPC507 ENVIRONMENTAL ENGINEERING LABORATORY Category: PC

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16CPC406 Water Supply Engineering

COURSE OBJECTIVES:

- To understand the sampling and preservation methods and significance of characterization of wastewater.

LIST OF EXPERIMENTS

1. Sampling and preservation methods for water and wastewater (Demonstration only).
2. Determination of pH & Electrical Conductivity.
3. Determination of Turbidity.
4. Determination of Chlorides.
5. Determination of Total Hardness.
6. Determination of Calcium Hardness.
7. Determination of Alkalinity.
8. Determination of Acidity.
9. Determination of Sulphates.
10. Determination of Iron & Fluoride.
11. Estimation of Residual Chlorine.
    a) Determination of Total Suspended solids.
    b) Determination of Dissolved solids.
    c) Determination of Fixed and Volatile solids.
    d) Determination of Total solids.
12. Determination of Optimum Coagulant Dosage.
13. Determination of Dissolved Oxygen.
14. Determination of BOD.
15. Determination of COD.
16. Standard Plate Count Test.

CONTACT PERIODS:

Lecture:0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Students are able to understand Sampling and preservation methods of water and wastewater

CO2: Students are able to test the physical properties of water and waste water.

CO3: Students are able to test the chemical properties of water and waste water.

CO4: Students are able to test the biological properties of water and waste water.

CO5: Students are able to test the Micro-biological properties of water and waste water.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M		L			L	L		M		M	L	L	H		L
CO2	M	H	L			L	M		M		M	L	L	H		L
CO3	M	H	L			L	M		M		M	L	L	H		L
CO4	M	H	L			L	M		M		M	L	L	H		L
CO5	L	L	L			L	M		M		M	L	L	H		L
16CPC 507	M	H	L			L	M		M		M	L	L	H		L

L-Low, M-Moderate (Medium), H-High

16CPC508 **SOIL MECHANICS LABORATORY** **Category: PC**

L	T	P	C
0	0	4	2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To impart practical knowledge on testing of soil for various properties such as physical, engineering, swell and insitu testing and its relevance in the selection and design of foundations.

LIST OF EXPERIMENTS

1. Moisture content determination.
2. Specific gravity and relative density test for sand.
3. Sieve analysis for coarse grained soil.
4. Hydrometer analysis for fine grained soil.
5. Consistency limits.
6. Field density tests (Sand replacement method and core cutter method).
7. Permeability tests – Constant Head method and variable Head method.
8. Direct Shear test.
9. Unconfined compression test for Soil.
10. Vane Shear Test for Cohesive Soil.
11. Standard Proctor's Compaction Test.
12. Consolidation Test.
13. Differential free swell tests.
14. Swell Pressure Test.
15. Triaxial Compression Test (Demonstration only).
16. Standard Penetration Test (Demonstration only).
17. SCPT and DCPT (Demonstration only).

CONTACT PERIODS:

Lecture:0 Periods **Tutorial:0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOME:

CO1: The student gains adequate knowledge on the physical properties and classify soil based on physical properties.

CO2: The student will be familiar with the engineering properties of soil and classify soil based on the engineering properties of soil.

CO3: Gain through knowledge on the swell characteristics of soils.

CO4: Able to judge the suitability of soil for different types of foundations.

CO5: The student acquires the knowledge on handling of field testing equipments.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H	M			L	L	M	M	H		H	H	M	
CO2	M	M	H	H			L	L		M	H			H	M	
CO3	M		H	M						H				H		
CO4	H		H					H	M	H	H	L		H	H	
CO5	H		H	H		H	H	H	H		H	H		H	H	H
16CPC 508	M	M	H	H		H	L	L	M	H	H	L	H	H	M	H

L-Low, M-Moderate (Medium), H-High

16CPC601 **STRUCTURAL ANALYSIS - II** **Category: PC**

L	T	P	C
3	2	0	4

PRE-REQUISITES:

1. 16CPC501 Structural Analysis – I

COURSE OBJECTIVES:

* To enhance the ability of students to analyse beams, frames and trusses using classical methods and matrix methods.

UNIT – I : SLOPE DEFLECTION METHOD (9+6)

Analysis of continuous beams - Sinking of Supports – Analysis of single storey and single bay rectangular vertical frames with and without sway - Gable portals.

UNIT – II : MOMENT DISTRIBUTION METHOD (9+6)

Distribution factor - Carry over factor – Analysis of continuous beams – Sinking of Supports – Analysis of single storey and single bay rectangular vertical frames with and without sway - Analysis of multistoried building frame for vertical loads by two cycle moment distribution method.

UNIT – III : ANALYSIS OF FRAME, PLANE AND SPACE TRUSSE (9+6)

Analysis of multistoried building frame for horizontal loads by portal method and cantilever method.

Analysis of plane trusses with maximum two redundant members by displacement and force methods –Trusses with lack of fit –Thermal Stresses –Analysis of Space trusses using method of tension coefficients - Trussed Beams.

UNIT – IV : MATRIX FLEXIBILITY METHOD (9+6)

Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.

UNIT – V : MATRIX STIFFNESS METHOD (9+6)

Analysis of continuous beams, indeterminate frames and trusses with maximum three degrees of kinematic indeterminacy.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

1. *Punmia B.C, "Strength of Materials and Mechanics of Structures, Vol.II.", Standard Publishers, 2007.*
2. *Pandit.G.S.and Gupta S.P., "Theory of Structure, Vol.I,", Tata McGraw–Hill ,NewDelhi, 2003.*
3. Vaidyanathan.R, Perumal.P., "Comprehensive Structural Analysis, Vol I and II", Laxmi Publications, 2008.

Reference Books:

1. Sterling Kinney, J "Indeterminate Structural Analysis", Narasa Publishing House, Delhi,1987.
2. Meek J.L, "Matrix Structural Analysis", Mc Graw – Hill Book Company,1971.
3. Negi, L.S. and Jangid, R.S,"Structural Analysis", 6th Edition, Tata McGraw-Hill Publications, 2003.
4. Rajasekaran S. and Sankarasubramanian .G, "Computational Structural Mechanics", Prentice Hall of India, 2001.
5. Manickaselvam.V.K, "Elementary Matrix Analysis of Structures", Khanna Publishers, New Delhi, 1994.
6. Bhavikatti.S.S, "Structural Analysis",Vol.I and II, Vikas Publishing House Pvt.Ltd.,2008.
7. Reddy.C.S, "Basic Structural Analysis",Third Edition, Tata McGraw-Hill Publications, 2011.

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Solve beams and frames using slope deflection.

CO2: Solve beams and frames using moment distribution methods.

CO3: Analyse frames, plane trusses and space trusses.

CO4: Analyse beams, frames and trusses by force methods.

CO5: Analyse beams, frames and trusses by displacement methods.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		L												H		
CO2		L	M	H												
CO3			M	H										L		
CO4	M	L	M													M
CO5	M	L														M
16CPC 601	M	L	M	H										H		M

L-Low, M-Moderate (Medium), H-High

16CPC602 **STEEL STRUCTURES** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CES303 Mechanics of Solids - I
2. 16CES402 Mechanics of Solids - II
3. 16CPC404 Basic Structural Design - I

COURSE OBJECTIVES:

- To study the behaviour and design of compression member subjected to eccentric force and design of base plate.
- To study the design of Gantry girder, welded plate girder, stiffeners and connections.
- To calculate the wind forces on steel stacks as per IS 875 and design the self-supporting steel stacks including base plate and anchor bolts.
- To introduce the concept of plastic analysis.

UNIT – I : PLASTIC ANALYSIS (09)

Introduction to Plastic analysis - ductility - plastic bending of beams - stages of bending - shape factor - plastic hinge - load factor - failure mechanism - upper and lower bound theorems of plastic analysis - collapse load for beams and frames.

UNIT – II : BEAM COLUMNS (09)

Introduction to beam - column - behaviour - equivalent moment factor - strength interaction - design of beam column - beam - column subjected to tension and bending - column bases - slab base - gusseted base - moment resistant base plate.

UNIT – III : PLATE GIRDERS AND GANTRY GIRDERS (09)

Welded plate girders – analysis and design using IS800-2007 - curtailment of flange plates – stiffeners – Splices - analysis and design of gantry girder.

UNIT – IV : ROOF TRUSSES AND INDUSTRIAL BUILDINGS (09)

Design of industrial building - roofing, cladding and wall material - structural components and framing - types of roof trusses - components - wind load estimation as per IS875 part 3 - design of purlins and wall girts using Channel and Angle sections - truss members - joints - cold formed steel purlin.

UNIT – V : STEEL STACKS (09)

Analysis and design of steel stacks - functional and structural requirements – self -supporting and guyed stacks - base plate and anchor bolt.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Subramanian N., "Design of steel structures" ,Oxford university press, 2008.*
2. *Duggal S.K., "Limit State Design of Steel Structures", Tata McGraw Hill., 1st Edition, NewDelhi, 2010.*
3. *"Teaching Resources for Structural Steel Design – Volume I and II", INSDAG, Kolkatta, 2009.*

Reference Books:

1. *Arya A.S. and Ajmani J.L., "Design of Steel structures".Nem Chand and Bros.Roorkee,2000.*
2. *Ramachandra, "Design of Steel structures" Vol I & II. Standard Book House, New Delhi, 2005.*
3. *IS:800-2007 - Code of practice for general construction in steel (Third revision).*
4. *P.Dayaratnam, "Design of steel structures", S.Chand Publishers 2011-12.*
5. *M.R. Shiyekar, " Limit State Design of Steel Structures",PHI Learning Private Ltd, NewDelhi,2011.*

COURSE OUTCOME:

CO1: Able to understand the design philosophy of industrial steel structures.

CO2: Ability to follow IS codes for the calculation of different types of loads and to analyze steel structural systems under gravity and lateral loads.

CO3: Apply the principles, procedures and current code requirements to the analysis and design of steel girders, industrial frames, chimneys and water tanks.

CO4: Identify and compute the design loads on industrial structures.

CO5: Able to understand the concept of plastic analysis.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M			L	L			M					L	M	L
CO2	M	M			M	M			H					M	M	L
CO3	M	H			M	M			H					M	H	H
CO4	L	H			L	M			H					M	H	H
CO5	M	M			M	H			H					M	H	M
16CPC 602	M	M			M	M			H					M	H	H

L-Low, M-Moderate (Medium), H-High

16CPC603 IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC503 Water Resources Engineering

COURSE OBJECTIVES:

- The student shall understand the need and mode of irrigation practiced in Tamilnadu.
- To get an idea about the functions and design of different hydraulic structures.

UNIT - I : IRRIGATION PRACTICE (09)

Necessity – Advantage and type of irrigation – methods of irrigation – Soil – water plant relations – main crops and their seasons – saline, alkaline soils and their reclamation – root cone depth – Duty and Delta – relationship – Factors affecting duty – optimum utilization of water – Consumptive use of water by a crop – Estimation – assessment of irrigation water – Irrigation efficiencies – Problems.

UNIT – II : DIVERSION HEAD WORKS (09)

Functions of diversion head works – Types – Layout of diversion head works – Component parts – functions - Weir – types – Causes of failure of weirs and their remedies – Design of impervious floor by Creep theories – Bligh's theory - Khosla's theory – Design of a vertical drop weir – Design principles for under sluices.

UNIT – III : GRAVITY DAM (09)

Forces acting and their computation – Modes of failures - Elementary profile of a gravity of a dam – Practical profile - High and Low gravity dams — Stresses acting on dam - Design procedure for a gravity dam – Zoning method – Function of Gallery and Joints in gravity dam - Problems to check stability Analysis – Spillways – Main types of Spillway.

UNIT – IV : ARCH, BUTTRESS AND EARTH DAMS (09)

Types of Arch dams – forces acting on it – advantages - Buttress dams – types and uses of buttress dams. Earth dam - types of earth dams – Method of construction - Section of earth dams – Causes of failure of earth dams - criteria for safe design of earth dams – Cross sections of earth dam according to materials- seepage control measures in earth dam.

UNIT – V : CANAL REGULATION WORKS (09)

Canal falls – types – Design of vertical drop fall – Functions of Regulators - Design of head and cross regulators – Cross drainage works – types of cross drainage works – Selection of suitable types of cross drainage works – Classification of aqueducts and syphon aqueducts – Design procedure of cross drainage works.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Santosh Kumar Garg, "Irrigation Engineering and Hydraulics Structures", Khanna Publications Pvt.Ltd. New Delhi, 2009.*
2. *Punmia .B.C. and Pande B.B.Lal, "Irrigation and Water Power Engineering", Laxmi Publications, Pvt.Ltd, New Delhi, 2009.*

Reference Books:

1. *Sharma. R.K. and Sharma.T.K "Irrigation Engineering and Hydraulics Structures", S.Chand & Company Pvt.Ltd, New Delhi, 2007.*
2. *Michel A.M., "Irrigation Engineering", Vikas Publishing House Pvt.Ltd, New Delhi, 2006*
3. *Madan Mohan Das and Mimi Das Saikia, " Irrigation and water power Engineering", PHI Learning Ltd, Delhi, 2014.*

COURSE OUTCOME:

CO1: The student would obtain knowledge on the needs and modes of irrigation system.

CO2: The students are able to know the importance of diversion head works.

CO3: The students would be able to check the stability of gravity dam.

CO4: The students are able to design the water storage structures for multipurpose.

CO5: The students would be able to select the appropriate type of canal regulation structures

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L						M	M			M	L	H
CO2	L					L	L		M	M		L	L	H	L	M
CO3	L	H	M	H	L		M				L			M	L	M
CO4	M		L	H		L			L				L	H	M	L
CO5	L	L		M	L			M		H		L		H	M	L
16CPC603	L	L	L	H	L	L	M	M	M	M	M	L	L	H	L	M

L-Low, M-Moderate (Medium), H-High

16CPC604 **DESIGN AND DRAWING – I**

(IRRIGATION AND ENVIRONMENTAL ENGINEERING)

Category: PC

L	T	P	C
1	0	4	3

PRE-REQUISITES:

1. **16CPC406 Water Supply Engineering**
2. **16CPC503 Water Resources Engineering**
3. **16CPC506 Waste Water Engineering**

COURSE OBJECTIVES:

- To understand the working and to design and develop plan, elevation and section of various irrigation structures and unit processes of a water and wastewater treatment plants.

PART – A

IRRIGATION ENGINEERING **(40)**

1. Tank Surplus Weir (Type A and D)
2. Tank Sluice with a Tower Head
3. Direct Sluice
4. Notch type Canal Drop
5. Canal Regulators and river regulators.
6. Cross-Drainage Works (Syphon Aqueduct type II & III)

PART – B

ENVIRONMENTAL ENGINEERING **(35)**

1. Intake tower
2. Screening device
3. Primary sedimentation tank
4. Clariflocculator
5. Slow and rapid sand filters
6. Secondary settling tanks
7. Trickling filter
8. Activated sludge process
9. Sludge digestion tank
10. Septic tank with dispersion trench and soak pit.
11. Infiltration gallery.

Note: Assignments include the design and drawings of various Irrigation and Environmental Engineering Structures.

QUESTION PAPER PATTERN:

Question paper shall consist of two questions from each part. Part A consist of 60 marks and Part B consist of 40 marks and the students have to answer one question from each part.

CONTACT PERIODS:
Lecture: 15 Periods Tutorial:0 Periods Practical: 60 Periods Total: 75 Periods

Text Books:

1. *Sathya Narayana Murthy Challa, "Water Resources Engineering Principles and Practice", New Age International (P) Ltd., New Delhi, 2005.*
2. *Rangwala.S.C, "Water supply and sanitary engineering", Charotar Publishing, 2016*

Reference Books

1. Santosh Kumar Garg, Irrigation Engineering and Hydraulics Structures, Khanna Publications Pvt.Ltd, New Delhi, 2009.
2. Birde.G.S and Birde.J.S, "Water supply and sanitary Engineering", Dhanpat Rai Publications Pvt.Ltd, New Delhi, 2014.

COURSE OUTCOME:

CO1: The students are able to design the different Hydraulic structures.
CO2: The students acquire hands on experience in preparation of drawings for Irrigation Structures.
CO3: The students are able to design the different Environmental Engineering structures.
CO4: The students acquire hands on experience in preparation of drawings for Environmental Structures.
CO5: The students are understand the importance of the Irrigation and Environmental Structures in real life.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L		M	M		L	L			H	L		L	H	M	L
CO2		L	L	L			M	L		M				M	L	
CO3	L		M	M		L	L			H	L		L	H	M	L
CO4		L	L	L			M	L		M				M	L	
CO5	L		M	M		L	L			H	L		L	H	M	L
16CPC 604	L	L	M	M		L	M	L		H	L		L	H	M	L

L-Low, M-Moderate (Medium), H-High

16CPC607 COMPUTER AIDED BUILDING DRAWING Category: PC

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16CES107 Engineering Graphics
2. 16CPC502 Basic Structural Design - II

COURSE OBJECTIVES:

* To learn about planning and preparation of building drawings as per Indian and International standards.
* To familiarize National Building code and bye-laws for planning any building.
* To learn drafting of detailed drawing of structural elements of any building in AutoCAD software with the regulations of Indian standards.

INTRODUCTION TO BUILDING DRAWING

Types of Buildings - Building Regulations as per Indian Standards – Drawing Tools - Standard Paper Size - BIS, ISO Specifications and Notations.

BUILDING PLANNING

Provisions of National Building Code - Building bye-laws - open area – setbacks- FAR terminology - Principles of planning - orientation - ventilation and lighting. Provisions for differently abled persons.

BUILDING ELEMENTS

Foundations - Plinth beam - Column- Beam - Slab- Lintel - Staircase - doors and windows - Types - Specifications - Standard sizes - Notations.

PLANNING OF RESIDENTIAL AND HOSPITAL BUILDINGS - INSTITUTIONAL, COMMERCIAL AND INDUSTRIAL BUILDINGS

An introduction to Building Information Modeling - Project phases - Collaboration in construction

LABORATORY EXERCISES

PREPARATION OF LINE SKETCHES IN ACCORDANCE WITH FUNCTIONAL REQUIREMENTS AND BUILDING RULES FOR THE FOLLOWING TYPES OF BUILDING AS PER NATIONAL BUILDING CODE:

1. Flat roof residential building
2. Pitched roof residential building
3. Multi-storeyed building
4. Industrial Building

DETAILED DRAWINGS (PLAN, ELEVATION AND SECTION FOR THE FOLLOWING) BY MANUAL AND BY USING AUTOCAD:

5. Detailed drawing for doors, windows
6. Planning, design and detail drawings of staircase
7. Flat roof building with load bearing wall
8. Pitched roof with load bearing wall
9. Framed structures
10. Industrial Building with North light roof truss

CONTACT PERIODS:
Lecture:0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods

Text Books:

1. *Kumara Swamy N. and KameswaraRao A., "Building Planning And Drawing", Charotar Publishing House Pvt. Ltd., 2013.*
2. Mark W. Huth Delmar, "Understanding Construction Drawings", Cengage Publishers, 2013.
3. Shah, M.G, Kale, C.M, Patki, S.Y, "Building Drawing - With an Integrated Approach to Built Environment", Tata McGraw-Hill, 2007.

Reference Books

1. Randy Shih, "Autocad 2016 Tutorial First Level - 2D Fundamentals", Schroff Development Corp, 2015.
2. Donald Watson, "Time-Saver Standards for Building Materials & Systems: Design Criteria and Selection Data", Tata McGraw Hill Education, 2009.
3. National Building Code of India 2005,Reprint edition, Bureau of Indian Standards, Govt. of India,2013.
4. IS 962:1989 Code of practice for architectural and building drawings
5. IS:7973 – 1976 code of practice for architectural and building working drawings

COURSE OUTCOME:

CO1: The student will be able to recognize the types of buildings, building regulations, paper sizes and tools for standard building drawing.

CO2: To impart knowledge about National Building Code, practice bye-laws and various IS codes relevant to construction drawings

CO3: The student will be able to prepare the plan and elevation of buildings according to Indian standards.

CO4: The students will be able to draw the plan, elevation and sectional views with the aid of software in accordance with functional requirements and buildings rules as per National Building Code.

CO5: The students will be able to communicate effectively the design data and specifications through the detailed drawing of various structural elements and requirements through BIM.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M								M							L
CO2	L				L				M					L	M	M
CO3	L	M	H		M				L	M				M	M	M
CO4	L	H	H		H				L	M				L	H	M
CO5	M	H	H		H				L					M	H	M
16CPC 607	L	H	H		H				L	M				M	H	M

L-Low, M-Moderate (Medium), H-High

16CPC608 **A - CONCRETE LABORATORY** **Category: PC**

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16CPC504 Concrete Technology

COURSE OBJECTIVES:

* To learn the testing procedures of cement and concrete as per IS codal provisions.

LIST OF EXPERIMENTS:

1. Normal consistency and initial & final setting time tests on cement
2. Fineness and Soundness test on cement.
3. Compressive strength of cement.
4. Slump cone test on concrete
5. Compaction factor test on concrete
6. Compressive strength of concrete cubes
7. Splitting tension test on concrete cylinders
8. Flexure test on concrete prisms
9. Concrete mix design using IS method.
10. Strength test on concrete using Rebound hammer (Demo only)
11. Quality test of concrete using ultrasonic tester (Demo only)

CONTACT PERIODS:

Lecture:0 Periods **Tutorial:0 Periods** **Practical: 30 Periods** **Total: 30 Periods**

COURSE OUTCOME:

CO1: Able to determine fresh concrete properties.
CO2: Able to determine the properties of cement.
CO3: Able to determine hardened properties of concrete.
CO4: Able to design concrete mix proportion.
CO5: Able to conduct non destructive testing.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		L	H							M		H		L	
CO2	H		L	H							M		H		L	
CO3	H		L	H							M		H		L	
CO4	H	L	L	H							M		H		L	L
CO5	H	M	L	H			L	L			M		H		L	L
16CPC608	H	M	L	H			L	L			M		H		L	L

L-Low, M-Moderate (Medium), H-High

16CPC608 **B - HIGHWAY LABORATORY** **Category: PC**

L	T	P	C
0	0	4	2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To impart practical knowledge on testing and quality control of aggregates and bitumen used for pavements.

LIST OF EXPERIMENTS

1. Aggregate Impact value test
2. Aggregate Crushing value test
3. Flakiness and Elongation Index Test
4. Attrition and Abrasion test
5. Specific gravity test
6. California Bearing ratio test
7. Penetration test on Bitumen
8. Viscosity test on Bitumen
9. Ductility test on Bitumen
10. Softening Point test on Bitumen
11. Binder content of Bitumen (Demonstration only)
12. Marshal stability test (Demonstration only)

CONTACT PERIODS:

Lecture:0 Periods **Tutorial:0 Periods** **Practical: 30 Periods** **Total: 30 Periods**

COURSE OUTCOME:

CO1: The students will be able to conduct strength tests on Aggregates.

CO2: The students will be able to conduct shape tests on Aggregates.

CO3: The students will be able to gain information on the testing of soil subgrade in the field as well as laboratory.

CO4: The students will be able to conduct quality control tests on Bitumen.

CO5: The students will be able to know about Bitumen mix design.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS01	PS02	PS03	PS04
CO1		M	L	H							L		L	M	H	
CO2			L	M		L										
CO3		M		H		L									H	M
CO4		M	L	H										H		
CO5		M	L	H											H	M
16CPC608		M	L	H		L					L		L	H	H	M

L-Low, M-Moderate (Medium), H-High

16CEE701 CONSTRUCTION MANAGEMENT Category: EEC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CES105 Materials in Construction
2. 16CPC306 Construction Technology

COURSE OBJECTIVES:

* To understand the basic concepts of management and software applications in construction projects.
* To plan, schedule and execute the construction projects based on materials, equipment, manpower and cost management.

UNIT – I : BASIC CONCEPTS IN MANAGEMENT (09)

Principles of Management – Role of project manager – Types and Stages of construction projects – Functions of Management – Types of organization – Types of Business Operations – Project delivery methods – Work Breakdown Structure.

UNIT – II : CONSTRUCTION PLANNING AND SCHEDULING (09)

Construction Planning – Estimation of activity duration – Scheduling – Scheduling techniques – Bar charts – Network techniques – Critical Path Method – PERT – Line of Balance method – Precedence Network Analysis – Crashing of Cost and Time – Resource Allocation and Leveling.

UNIT – III : MATERIALS AND EQUIPMENT MANAGEMENT (09)

Materials management – Functions – Materials Planning – Procurement – Inventory Control – ABC analysis, VED analysis, FSN analysis, SDE analysis and HML analysis.
Equipment Management – Construction equipment – Earth-moving equipment, Compactors, Hauling and Hoisting equipment – Equipment Planning and Selection – Buying versus leasing of construction equipment.

UNIT – IV : HUMAN RESOURCE MANAGEMENT (09)

Scope and objectives of HRM – Manpower policy and planning – Recruitment and selection – Training Performance appraisal – Wage Policy and Compensation systems – Company union relationship and collective bargaining – Accidents – Absenteeism and Labour Turn over – Grievances/Conflicts – Identification and resolution.

UNIT – V : COST MANAGEMENT AND SOFTWARE APPLICATIONS (09)

Cost Management: Classification of construction cost – Cost coding – Cost Estimation – Project Budget – Financial accounting systems – Cost control – Cash flow.

Software Applications: Project management software – Introduction to MS project and Primavera software.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Chitkara, K.K., "Construction Project Management Planning, Scheduling and Controlling", Tata McGraw Hill Publishing Company Ltd., 2014.*
2. *B Sengupta H Guha, "Construction Management and Planning", Tata McGraw Hill Company Ltd., 2005.*
3. *Sharma .S.C., "Construction Engineering and Management", Khanna Publishers, 2008.*

Reference Books:

1. *Kumar Neeraj Jha, "Construction Project Management: Theory and Practices", Pearson Publications, 2015.*
2. *Sidney M. Levy, "Project Management in Construction", Tata McGraw Hill Company Ltd., 2013.*
3. *Daniel W. Halpin, Bolivar A. Senior, "Construction Management", Wiley Publishers, 2010.*
4. *Subramaniam, "Construction Management", Anuradha Publications, 2001.*

COURSE OUTCOME:

CO1: The students acquire knowledge in the basic concepts of management to execute the construction works with the available resources.

CO2: The students can able to plan and schedule the construction projects at resource constraints using network techniques.

CO3: The students can utilize the materials, equipment, manpower and cost effectively in construction industry.

CO4: The students gain knowledge in cost estimation, project budget preparation and cost control in executing the project.

CO5: This subject also helps the students in maintaining financial accounting systems and application of project management software.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L			M				H	M		L		H		M	L
CO2	L	H	L	L	L	L	L		L	L	M	L	L		H	M
CO3	L		H		M	M	H		M	M	L	M	H	L	M	M
CO4		L			L	H		M	L				M		L	L
CO5			M					H	H			H	L		M	H
16CEE 701	L	H	H	M	L	H	H	H	M	M	L	H	H	L	M	M

L-Low, M-Moderate (Medium), H-High

16CPC702 FOUNDATION ENGINEERING Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC505 Mechanics of Soils

COURSE OBJECTIVES:

* Student acquires the knowledge of field soil investigation and testing, besides design of shallow, pile foundation based on bearing capacity and settlement. Knowledge on earth pressure and stability of slopes is also improved.

UNIT – I : SELECTION OF FOUNDATION AND SOIL EXPLORATION (09)

Types of foundation – Requirements of good foundation – Factors governing location and depth – Choice of types of foundation. Soil exploration – Objectives – Planning – Number of spacing and Boreholes –Methods of Exploration– Depth of exploration – Samples –Disturbed and undisturbed – Samplers – Soundings – SPT – SCPT – DCPT – Bore log.

UNIT – II : BEARING CAPACITY (09)

Bearing capacity – Terzaghi's Bearing capacity theory – Types of failures – Effect of water table – Correction for size, shape and depth – Skempton's formula – Meyerhoff's formula – Hansen's formula – Inclination of load and eccentricity of load on bearing capacity – BIS formula –Bearing capacity from insitu tests – Methods of improving bearing capacity.

UNIT – III : SETTLEMENT AND DESIGN OF FOUNDATION (09)

Settlement – Immediate and time dependent settlements – Differential settlement – Causes – Effect – Control – Permissible settlement – BIS code provisions – Contact pressure distribution – Design – Proportioning – Isolated footing, combined footing and strap footing - raft foundation – Types – Floating foundation.

UNIT – IV : PILE FOUNDATIONS (09)

Classification and Selection of piles – Functions – Merits – Load carrying capacity –Static and dynamic formulae – Pile load test – Capacity from penetration test –Pile groups – Efficiency – Feld's rule –Converse Labarre formula – Spacing and group action – Efficiency of pile group – Settlement – Negative skin friction –Under reamed pile foundation.

UNIT – V : STABILITY OF SLOPES AND EARTH PRESSURE (09)

Stability of slopes – Infinite and finite slopes – Types of failure – Slip circle method – Friction circle method – Taylor's stability chart. Lateral earth pressure – Plastic equilibrium – Rankine's theory – Surcharge – Inclined backfill – Stratified backfill – Coulomb's theory – Earth pressure on retaining walls of simple configurations – Graphical constructions (Rebhan's and Culmann's graphical procedure) – Stability analysis of retaining wall – Drainage of backfill.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *VargheseP.C., "Foundation Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2006.*
2. *Venkatramiah.C., "Geotechnical Engineering", New Age International (P) Ltd. publishers, New Delhi,2006.*

Reference Books:

1. Teng. W.L., "Foundation Design" Prentice Hall of India Ltd., New Delhi, 1969.

2. ShashiK.Gulhati and ManojDatta ,Geotechnical Engineering", Tata McGraw Hill Publishing Company Ltd., NewDelhi, 2005.

3. Tomlinson M.J., "Foundation Engineering", Wiley Eastern Ltd., 1980.

4. Joseph E., Bowles, "Foundation Analysis and Design", McGraw Hill publishing Co., 1986.

COURSE OUTCOME:

CO1: Students are able to understand the various methods of soil exploration, field testing and to select suitable foundation based on soil conditions.

CO2: Able to estimate the bearing capacity of soils.

CO3: Able to calculate settlement and to design various types of foundation.

CO4: Able to select piles for different conditions and calculate the load carrying capacity.

CO5: Students will be able to analyse stability of slopes and calculate earth pressure on retaining walls.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	M	H	M	H	H	H	H			M	H	M	H
CO2		H	H		M	M	H	M	H	L	H	M		H	M	
CO3	M	H		H					H	H	M			H		H
CO4	H	H					H	L	H	H	M			H	H	H
CO5	H		H	H			H	L				M		H	H	
16CPC 702	H	H	H	H	H	M	H	L	H	H	M	M	M	H	H	H

L-Low, M-Moderate (Medium), H-High

16CPC703 **CONCRETE STRUCTURES** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC404 Basic Structural Design – I
2. 16CPC502 Basic Structural Design – II

COURSE OBJECTIVES:

* To learn the types of footings, choice of foundation and its design concept.
* To learn the design procedures for complex structures like retaining walls, flat slabs and water tanks.
* To make the students to know about the earthquake resistant design and ductile detailing of structures.

UNIT – I : FOOTINGS (09)

Design of Eccentrically loaded footings for columns – Combined rectangular footings – Combined trapezoidal footings for axially loaded column - Strap beam footings – Design steps of raft foundations.

UNIT – II : RETAINING WALLS (09)

Types of retaining walls – Structural behaviour of retaining walls- Stability of retaining wall against over-turning sliding and pressure developed under the base - Design of Cantilever retaining wall and Counterfort retaining wall.

UNIT – III : FLAT SLAB DESIGN (09)

Design loads other than earthquake loads (only an introduction) – Imposed loads, wind loads, construction loads. Design of Flat slabs by BIS code – Middle panel and End panel – Column strip – Middle strip – with and without column head –reinforcement details.

UNIT – IV : WATER TANKS DESIGN (WORKING STRESS METHOD) (09)

Design of underground and on ground rectangular and circular tanks – Overhead tanks of rectangular shape and circular shape with flat roof – BIS code method -Design of all components including staging and foundation.

UNIT – V : EARTHQUAKE FORCES – DUCTILE DETAILING (09)

Earthquake forces – Bureau of Indian standards for Earthquake resistant design – earthquake magnitude and intensity – Basic seismic coefficients and seismic zone factors – design forces – design factors – Analysis of structures– choice of method for multistoreyed buildings. Ductile detailing of frames for seismic forces – general principles.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Pillai and Menon, "Reinforced Concrete Design", McGraw Hill Education (India) Private Ltd., 2016.*
2. *Sinha.S.N., "Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd., 2003.*
3. *Pankaj Agarwal and Manish ShriKhande, "Earthquake Resistant Design of Structures", Prentice-Hall of India, New Delhi, 2006.*

Reference Books:

1. *BIS 456 – 2000, Indian Standard code of Practice for plain and Reinforced concrete.*
2. *BIS 3370-Part 4 - Code of practice for concrete structures for the s to rage of liquids.*
3. *BIS 1893-2002- Criteria for Earthquake resistant design of structures.*
4. *IS 13920(1993), "Ductile detailing of Reinforced concrete structures subjected to seismic forces".*
5. *Ramachandra, "Design of Concrete Structures – Vol 1", Standard Book House, Delhi-6.*
6. *V.L.Shah and S.R.Karve "Limit state theory and design of reinforced concrete", Structure publications.*
7. *Vazirani & Ratwani, Design of R.C.C Structures, Khanna Publishers.*

COURSE OUTCOME:

CO1: The students will be able to make the choice of foundation and its design as per BIS code.

CO2: The students will be able to make the choice of retaining walls and its design as per BIS code.

CO3: The students will be able to design Flat slabs as per BIS code.

CO4: The students will be able to make the choice of water tanks and its design as per BIS code.

CO5: The students will be able to apply the provisions of earthquake resistant design and ductile detailing of structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		H		L	M								L	M	H	
CO2				L		H		M							H	
CO3			M	L		H									H	M
CO4				M		H	L								H	
CO5		L		M		H		M							H	M
16CPC 703		H	M	L	M	H	L	M					L	M	H	M

L-Low, M-Moderate (Medium), H-High

16CPC704 DESIGN AND DRAWING – II (CONCRETE AND STEEL)

Category: PC

L	T	P	C
1	0	4	3

PRE-REQUISITES:

1. 16CPC602 Steel Structures

COURSE OBJECTIVES:

* The students are able to do design and detailing of reinforced concrete and steel structures.

PART – A (40)

Detailed design and drawing of the following concrete structures:

1. Beams – Simply Supported, Continuous, Cantilever. (Singly Reinforced, Doubly Reinforced and T beams)
2. Slabs – Simply Supported, Continuous. (One way, Two way and Flat slabs)
3. Footings – Isolated and Combined footings (Rectangular, Trapezoidal)
4. Retaining Wall - Cantilever and Counterfort types.
5. Water Tank – Circular and Rectangular. (Design up to base slab)

PART – B (35)

Detailed design and drawing of the following Steel structures:

1. Column base – Slab base and gusseted base.
2. Seated connections – stiffened and unstiffened.
3. Moment resistant connections.
4. Welded plate Girder
5. Simple trusses with connections.

QUESTION PAPER PATTERN:

Question paper shall consist of two questions from each part. Part A consists of 60 marks and Part B consists of 40 marks and the students have to answer one question from each part.

CONTACT PERIODS:

Lecture:15 Periods Tutorial:0 Periods Practical: 60 Periods Total: 75 Periods

Text Books:

1. *Pillai.S, Devdas Menon, "Reinforced concrete Design", Mcgraw Hill Education, 2009.*
2. *Duggal .S.K, "Design of steel structures", Tata Mcgraw –Hill Publishing company Ltd, 2009.*
3. *N.KrishnaRaju, "Structural Design and Drawing", University Press, 2005.*

Reference Books:

1. *Ramchandra, "Limit State Design", Standard Book House, Delhi-6, 2005.*
2. *Sinha.S.N, "Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd., 2005.*
3. *Krishna Raju N and Pranesh, R.N., "Reinforced Concrete Design – IS 456 – 2000 Principles and Practice", New Age International Publishers, New Delhi, 2003.*

COURSE OUTCOME:

CO1: The student acquires hands on experience in design drawings of RCC beams and slabs.

CO2: Students are able to do detailed design and drawing of footings and retaining walls.

CO3: Students are able to do detailed design and drawing of water tanks.

CO4: Students are able to do detailed design and drawing of seated and moment resistant connections.

CO5: Students are able to do detailed design and drawing of plate girder and trusses.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M		L									L			L
CO2	H					L										
CO3	M	L		L												
CO4	M															
CO5	M	L		L		M							L			L
16CPC704	M	L		L		M							L			L

L-Low, M-Moderate (Medium), H-High

16CEE707 **ESTIMATION AND COSTING** **Category: EEC**

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16CPC602 Steel Structures

COURSE OBJECTIVES:

* The students are able to estimate and costing of various types of buildings and also able to prepare tender and contract documents of project.

UNIT - I : ESTIMATION FUNDAMENTALS (09)

Importance of estimation, different types of estimates, general and detailed specifications. Methods of Estimation: Items of work for estimates, units and measurement of items.

UNIT – II : DETAILED ESTIMATION OF BUILDINGS AND RATE ANALYSIS (09)

Preparation of detailed estimate for RCC single storey and two storey residential framed structures - Estimates of Steel Framed Industrial Building -PWD Schedule of rates and data sheets – requirements of labour and materials for different types of works. Costing – Approximate methods of costing.

UNIT – III : ROAD ESTIMATES AND RATE ANALYSIS (09)

Preparation of detailed estimate and rate analysis for flexible pavements- Highway schedule of rates- Costing of roads.

UNIT – IV : TENDER AND CONTRACT, VALUATION (09)

Tender notice – Types – Corrigendum notice – Tender procedures – Drafting – model tenders. Contract – types of contract – contract for labour and material – work order – billing – running account bill (both Client and Sub contractor's bill)- Valuation – types of valuation – escalation – evaluation.

UNIT – V : ESTIMATION AND COSTING BY SOFTWARE TOOLS (09)

Estimation of quantities and rate abstracts for Single and two storey residential buildings-Steel industrial building (by using Excel) – Introduction to Tekla detailing software.

CONTACT PERIODS:

Lecture:0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods

Text Books:

1. *S.Dutta, "Estimation and costing in Civil Engineering", UBS publishers Limited, 2007.*
2. *Bhasin, P.L., "Quantity Surveying", 2nd Edition, S.Chand & Co., 2000.*

Reference Books:

1. *Jagannathan, G. "Getting more at less cost – The value Engineering way", Tata McGraw Hill Publishing company, New Delhi, 2000.*
2. *Sengupta, "Construction Engineering and Management", Tata McGraw Hill Publishing company, New Delhi, 2001.*

COURSE OUTCOME:

CO1: The students will able to learn about the various aspects of estimation of quantities of items of works involved in buildings / road works.

CO2: The students will able to learn about the rate analysis, valuation of properties and preparation of reports for estimation of various items.

CO3: The students will able to estimate the material quantities, prepare a bill of quantities, make specifications and prepare tender documents.

CO4: The students will able to prepare value estimates.

CO5: The students will be able to get the knowledge of Estimation softwares.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M				L					H		L	M	H	
CO2														H		
CO3	L	M													H	M
CO4					H						H			H		
CO5		L	H					L		M					H	M
16CEE 707	L	M	H		H	L		L		M	H		L	H	H	M

L-Low, M-Moderate (Medium), H-High

16CPC708 COMPUTER APPLICATION LABORATORY Category : PC

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16CES206 Engineering Mechanics
2. 16CES303 Mechanics of Solids – I
3. 16CES402 Mechanics of Solids – II
4. 16CPC404 Basic Structural Design – I (Masonry and Steel)
5. 16CPC502 Basic Structural Design – II (Concrete)
6. 16CPC602 Steel Structures

COURSE OBJECTIVES:

- To improve the programming skills for analysis and design of structures.
- To use the modern computing tools to formulate analyze and design of various concrete and steel structures.
- To study the behaviour and design of members subjected to various loading cases.
- To study the analysis and design of various 2D & 3D Truss and Frames.
- To study the behaviour of structural systems using the concept of Finite element analysis packages.

DESIGN OF STRUCTURAL ELEMENTS USING EXCEL SPREADSHEET

1. Design of RCC rectangular beams, Tee beams and L beams.
2. Design of one way slab and two way slab.
3. Design of columns.
4. Design of Isolated and combined footing.
5. Design of Raft footing.

ANALYSIS AND DESIGN OF STRUCTURES USING STAAD PRO AND ETABS

1. 2D and 3D Trusses.
2. 2D and 3D Frames.
3. Steel Gable Frames.
4. Multi storey buildings.
5. Water tanks

BEHAVIOUR OF STRUCTURAL ELEMENTS USING ANSYS AND ABAQUS

1. Trusses
2. Frames.
3. Slabs

CONTACT PERIODS:

Lecture:0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods

Text Books:

1. *Krishnamoorthy C.S., and Rajeev S., "Computer Aided Design and Analytical tools", Narosa., 2000.*
2. Isaac D. Gottlieb, "Next Generation Excel, 2nd edition".
3. Krishnamoorthy C.S., "Finite Element Analysis- Theory and Programming, Second Edition", Tata McGrawHill Publishing Co., 2004.

Reference Books:

1. WebTech Sol., "Mastering Microsoft Excel Functions and Formulas".

2. Paleti Srinivas, Krishna Chaitanya Sambana and Rajesh Kumar Datti., "Finite Element Analysis using ANSYS", PHI Learning Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOME:

CO1: Able to recognize the design philosophy of structural components

CO2: Ability to follow IS codes for the calculation of different types of loads and to analyze the structural systems under gravity and lateral loads.

CO3: Apply the principles, procedures and current code requirements to the analysis and design of steel and reinforced concrete structures.

CO4: Identify and compute the design loads on industrial structures

CO5: Able to identify the behavior of structural systems by using the finite element analysis software packages (ANSYS and Abaqus)

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L			L			M						M	H	M
CO2	M		M		M			H						L	L	M
CO3	H	H	L	H	L			H						L	L	M
CO4	H	H	M	H	L									H	M	
CO5	H	H	H	H	M	H									H	
16CPC708	H	H	M	H	L	H		H						L	H	M

L-Low, M-Moderate (Medium), H-High

16CEE709 **MINI PROJECT** **Category : EEC**

L	T	P	C
0	0	8	4

PRE-REQUISITES:

1 All Civil Engineering Subjects

COURSE OBJECTIVES:

1 To enable the students to apply the theoretical knowledge in practice.
2 To impart and improve the design capability of the student.

COURSE CONTENT:

It will be assigned by the Department for maximum of four students in a group, under the guidance of a Supervisor. This course envisages purely a design problem in any one of the disciplines of Civil Engineering.

The Mini Project includes:

* Survey and collection of relevant data on the assigned topic
* Working out a preliminary Drawings to the Problem relating to the topic
* Conducting preliminary & detailed Analysis/Modelling/Simulation/Design/Feasibility
* Preparing a Written Report on the Study conducted
* Final Seminar, as oral Presentation before a Departmental Committee

CONTACT PERIODS:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 120 Periods** **Total: 120 Periods**

COURSE OUTCOMES:

On completion of the course , Students will be able to

CO1: Identify Civil Engineering Analytical Problems.
CO2: Understand the IS Codes & Develop the general arrangement drawings.
CO3: Do detailed Analysis and produce detailed drawings.
CO4: Produce approximate project cost.
CO5: Prepare the final detailed report.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L	L	M	H	H	H	M	H	H	H	M	H	M	H	M
CO2	H	M	H	L	H	M	H	L	M	M	L	H	L	H	M	M
CO3	H	H	H	H	H	M	M	H	M	M	M	H	M	M	H	L
CO4	H	M	H	M	M	L	L	L	H	H	H	M	L	M	H	M
CO5	M	L	L	M	H	H	M	L	M	H	H	M	L	L	M	L
16CEE709	H	M	H	M	H	H	H	L	M	H	H	M	L	M	H	M

L-Low, M-Moderate (Medium), H-High

16CEE801 **PROJECT WORK** **Category : EEC**

L	T	P	C
0	0	16	8

PRE-REQUISITES:

1 All Civil Engineering Subjects.

COURSE OBJECTIVES:

1 To enable the student to take up investigative study in the broad field of Civil Engineering, either fully Theoretical/Practical or involving both Theoretical and Practical work.

COURSE CONTENT:

It will be assigned by the Department for maximum of four students in a group, under the guidance of a Supervisor. During this period the students shall receive directions from the Supervisor for the progress of the Project Work. The students shall give periodical presentations of the progress made in the Project Work. Each student shall finally produce a comprehensive report. This final report shall be typewritten form as specified in the guidelines.

The Project Work shall be carried out in any of the Civil Engineering areas

The Project Work includes:

* Review and finalization of the Approach to the Problem
* Preparing an Action Plan for conducting the investigation, including team work.
* Detailed Analysis /Design/ Experiment as needed
* Final development of product/process, testing, results and conclusions.
* Final Seminar Presentation before a Departmental Committee

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Identify Specific Civil Engineering area and work for the real life needs.

CO2: Familiarize with the Standard Codes for specific Civil Engineering works.

CO3: Apply latest techniques to Analyze, Modelling and Simulation work.

CO4: Give practical solutions to Civil Engineering Problems.

CO5: Prepare the final detailed report.

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L	L	M	H	H	H	M	H	H	H	M	H	M	H	M
CO2	H	M	H	L	H	M	H	L	M	M	L	H	L	H	M	M
CO3	H	H	H	H	H	M	M	H	M	M	M	H	M	M	H	L
CO4	H	M	H	M	M	L	L	L	H	H	H	M	L	M	H	M
CO5	M	L	L	M	H	H	M	L	M	H	H	M	L	L	M	L
16CEE801	H	M	H	M	H	H	H	L	M	H	H	M	L	M	H	M

L-Low, M-Moderate (Medium), H-High

16CPE001 FUNDAMENTALS OF REMOTE SENSING AND GIS APPLICATIONS **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC305 Surveying – I
2. 16CPC405 Surveying – II

COURSE OBJECTIVES:

* To introduce the students to the basic concepts and principles of various components of remote sensing.
* To provide an exposure to GIS and its practical applications in civil engineering.

UNIT – I : PRINCIPLES OF REMOTE SENSING (09)

Definition – Historical background – Basic principles and methods of remote sensing – Electromagnetic radiation and source – Electromagnetic spectrum – Wave and particle theory – energy equations – Interference - Atmospheric effects on remote sensing – Atmospheric windows – Energy interaction with surface features – Reflectance – Specular and diffuse reflection surfaces – Spectral signatures – Spectral signature curves – Thermal and microwave.

UNIT – II : REMOTE SENSING DATA ACQUISITION (09)

Data acquisition – Active and passive remote sensing – Platforms – Aerial and space platforms – Aircraft and satellites– Synoptivity and Repetivity – Sensors – Aerial camera – Non-photographic optical sensors – Multispectral scanners –Thermal scanners, Imaging radars – SLAR and SAR LIDAR.

UNIT – III : SATELLITE REMOTE SENSING AND DIGITAL IMAGE PROCESSING (09)

Satellites – Classification – Based on orbits – Based on purpose – Remote sensing satellites – LANDSAT, SPOT, IRS and IKONOS – Their orbital characteristics – Sensors onboard – Characteristics of thermal imagery and radar imagery– Comparison with image types – Characteristics of digital image processing – Pre-processing – Image enhancement –Filtering – Classification.

UNIT - IV : GEOGRAPHIC INFORMATION SYSTEM (09)

GIS – Components of GIS – Hardware, Software and organizational set up – Data – Spatial and Non spatial – Maps –Types of maps – Map Projection – Types of projection – Data input – Digitization – Editing – Raster and Vector data structures – Comparison – Analysis using Rastor and Vector data – Retrieval, Reclassification, Overlying, Buffering –Data output – Printers and plotters.

UNIT – V : SATELLITE IMAGERY AND GIS APPLICATIONS (09)

Application of satellite imagery – Merits – Limitations – Comparison with aerial photographs – Visual interpretation of satellite imagery – Elements of interpretation – Interpretation keys-
GPS and its Applications- Application of remote sensing and GIS in Surveying, Water resources exploration – Land use/Land cover studies – Geology –Agriculture, Disaster Management, Coastal zone Management and Environmental Engineering.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *A M Chandra ,S.K.Ghosh, "Remote Sensing and Geographical Information system", Narosa Publishing house New Delhi,2006.*
2. *Patel A.N and Surendra singh, "Remote Sensing Principles and Applications", Scientific Publishers, Jodhpur, 2001.*
3. *Anji Reddy, "Remote Sensing and Geographical Information system", BS Publications, 2001.*
4. *M.G. Srinivas (Edited by) , "Remote sensing applications", Narosa publishing House, 2001.*

Reference Books:

1. *Thomas M.Lille sand & Raiph W.Kiefer, "Remote sensing and Image Interpretation "John Wiley Sons, 2004.*
2. *Burrough P.A, Principles of GIS for land resources assessment, Oxford, 2002.*

COURSE OUTCOME:

CO1: Students understand the principles and methods of remote sensing.

CO2: The students will able to apply the concept of satellite remote sensing, Data acquisition.

CO3: Get idea of various satellites such as LANDSAT, SPOT and IRS series, types and Characteristics of imageries.

CO4: To know about the hardware and software of GIS.

CO5: To acquire knowledge on the application of GIS in the areas of water resources, land use studies, soil science, Agriculture, forestry and Oceanography.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		M					H				M	L	H	L	M
CO2				H	H						L					
CO3						L								H		
CO4	M		M				H	H					M	H	M	M
CO5		M			M					M		H		H		
16CPE001	H	M	M	H	H	L	H	H		M	L	H	M	H	M	M

L-Low, M-Moderate (Medium), H-High

16CPE002 **RAILWAY ENGINEERING** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The students are able to plan, design and construction of railway networks and stations.

UNIT – I : INTRODUCTION TO RAILWAY PLANNING AND RAIL ELEMENTS (09)

Historical development of Indian railways- Railways for Urban Transportation –LRT & MRTS- Engineering survey- Gauge – Elements of permanent way –Rails, sleepers, ballast, rail fixtures and fastenings- coning of wheels- creep in rails - defects in rails.

UNIT – II : RAILWAY GEOMETRIC DESIGN (09)

Geometric design of railway track-gradient, super elevation, widening of gauge on curves- Transition Curves - Horizontal and Vertical Curves.

UNIT – III : RAILWAY STATION YARDS AND OPERATIONS (09)

Railway station -yards – points and crossings –Turnouts – Switches – Equipments at stations.

UNIT – IV : RAILWAY CONSTRUCTION AND MAINTENANCE (09)

Construction of track - Earthwork – Consolidation- Plate laying – Ballasting –Doubling of railway lines – Gauge Conversion - maintenance of tracks – modern methods – Track Drainage.

UNIT – V : SIGNALLING AND INTERLOCKING (09)

Signaling – Objective – Classification – Signalling systems- Interlocking- maintenance of signals – Modern signaling installations.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *S.C. Saxena , S.P.Arora*, "*A Text Book of Railway Engineering", Dhanpat Rai and Sons, 2010.*
2. Satish Chandra, "*M.M. Agarwal Railway Engineering", Oxford university press, 2013.*

Reference Books:

1. Rangwala , "Railway Engineering", Charotar Publishing House, 2012
2. Vazirani.V.N. and Chandola.S.P., "Transportation Engineering-Vol.1", Khanna Technical Publications, NewDelhi, 1991.

COURSE OUTCOME:

CO1: The students gain information regarding the basics of railway engineering and railway components.

CO2: Students will be able to do geometric design of railway network.

CO3: Students will be able to plan and design of stations and yards

CO4: Students gain information regarding railway construction and maintenance.

CO5: Students are able to know about the signals and control systems in railway engineering.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L			M			H				L			L		
CO2	L	H		L		H					M			L	H	
CO3	L		M	M	L		L				M			L	H	
CO4	L	M	H	M	L	H	L	L				L	H	L	H	
CO5	L	M					H	L	M	L		L		L		H
16CPE002	L	M	H	M	L	H	H	L	M	L	M	L	H	L	H	H

L-Low, M-Moderate (Medium), H-High

16CPE003 SMART MATERIALS AND SMART STRUCTURES Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To make the students to gain knowledge on smart materials, strain measuring techniques, signal processing and control systems.

UNIT – I : INTRODUCTION (09)

Introduction to Smart Materials and Structures - Instrumented structures functions and response - Sensing systems – Self -diagnosis - Signal processing consideration -Actuation systems and effectors.

UNIT – II : MEASURING TECHNIQUES (09)

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

UNIT – III : SENSORS (09)

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 (09)

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

UNIT – V : SIGNAL PROCESSING AND CONTROL SYSTEMS (09)

Data Acquisition and Processing - Signal Processing and Control for Smart Structures - Sensors as Geometrical Processors- Signal Processing - Control System - Linear and Non-Linear.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. Brain Culshaw, "Smart Structure and Materials", Artech House – Borton, London, 2003.
2. Srinivasan, A.V. and Michael McFarland, D., "Smart Structures: Analysis and Design", Cambridge University Press, 2010.
3. Yoseph Bar Cohen, "Smart Structures and Materials", The International Society for Optical Engineering,2003.

Reference Books:

1. L. S. Srinath, "Experimental Stress Analysis", Tata McGraw Hill, 2004.
2. J. W. Dally & W. F. Riley, "Experimental Stress Analysis", Tata McGraw Hill Company.

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Know the functions and response of instrumented structures using smart materials

CO2: Measure strain using electrical strain gauges.

CO3: Know the various sensing technologies.

CO4: Have knowledge on actuator materials and actuator techniques

CO5: Know about the control systems for smart structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M														
CO2				M											L	
CO3		M														
CO4	H															
CO5		L													M	
16CPE003	H	M		M											M	

L-Low, M-Moderate (Medium), H-High

16CPE004 MAINTENANCE AND REHABILITATION OF STRUCTURES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC504 Concrete Technology

COURSE OBJECTIVES:

* To make the students gain the knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures

UNIT - I : MAINTENANCE AND REPAIR STRATEGIES (09)

Maintenance, repair and rehabilitation, Facets of Maintenance, Importance of Maintenance Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration, Diagnosis of causes and preventive measures.

UNIT – II : SERVICEABILITY AND DURABILITY OF CONCRETE (09)

Quality assurance for concrete construction, Factors affecting concrete properties – strength, permeability, thermal properties. Effects due to climate, temperature, chemicals, aggressive environment. Design and construction errors – Causes and effects of corrosion – Causes and effects of cracks, types of cracks – Cover thickness requirements.

UNIT - III : MATERIALS FOR REPAIR (09)

Materials for accelerated strength gain, concrete chemicals, Expansive cement, Ferrocement, Polymer concrete, Sulphur infiltrated concrete, Foamed concrete, Fibre reinforced concrete.

UNIT - IV : TECHNIQUES FOR REPAIR AND DEMOLITION (09)

Rust eliminators and polymer coating for rebars during repair, Mortar and dry pack method, vacuum concreting, Guniting and Shotcreting, Epoxy injection, Shoring and underpinning. Methods of corrosion protection- Corrosion inhibitors, coating and cathodic protection. Engineered demolition techniques for Dilapidated structures – case studies.

UNIT – V : REPAIRS, REHABILITATION & STRENGTHENING OF STRUCTURES (09)

Repairs to overcome deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure. Strengthening of Super Structures- Jacketing, Reinforcement addition, Plating, Conversion to composite construction, Post stressing. Strengthening of substructures.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods 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
3. Dr.B.Vidivelli, "Rehabilitation of concrete structures", Standard Publishers, 2011.

Reference Books:

1. M.S.Shetty, Concrete Technology – Theory and Practice, S.Chand and Company, New Delhi, 2008.
2. M.L. Gambhir, Concrete Technology, Tata Mc-Graw Hill Company, Noida, 2013.
3. Santhakumar, A.R., Training Course notes on Damage Assessment and repairs in Low Cost Housing, "RHDC– NBO" Anna University, July 1992.
4. Lakshmipathy, M. etal. Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 -30th October 1999.
5. Johnson,S.M., "Deterioration, Maintenance and repair of Structures", McGraw-Hill Book Company, Newyork,1965.

COURSE OUTCOME:

CO1: The students will be able to evaluate a damaged structure.

CO2: The students will be able to verify the quality assurance of the construction.

CO3: The students will be able to identify and choose the appropriate materials and techniques for various repair conditions.

CO4: The students will be able to execute various engineered demolition techniques for dilapidated structures.

CO5: The students will be able to rehabilitate and strengthen the various elements of a structure subjected to deterioration.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		L				H		M				M			H	
CO2				M	L			L				H	M		L	
CO3		L	H			M		M					L			M
CO4			H			M						M	L		M	L
CO5		H	M			M		L				H			M	H
16CPE004		L	H	M	L	M		M				H	L		M	H

L-Low, M-Moderate (Medium), H-High

16CPE005 SAFETY IN CIVIL ENGINEERING PRACTICES Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC306 Construction Technology

COURSE OBJECTIVES:

- To impart the basic knowledge about safety requirement at every stage of construction work.

UNIT - I : PRE-CONSTRUCTION (09)

Planning and scheduling – Housekeeping – Safe access – Site safety – Basic checklist – Electrical Safety – Electrical power lines –Temporary Wiring – Overhead high-voltage and low-voltage electricity – Underground electrical hazards.

UNIT – II : CONSTRUCTION (09)

Personal Safety – Basic personal protective equipment and clothing – Eye and Face protection, Foot protection, Hand protection, Head protection and Hearing protection – Safety related work practices – Safety measures during Excavation – General requirements for trenches and excavations, Sloping and shoring requirements, Underground construction.

UNIT - III : FORMWORK AND POURING (09)

Safety measures for Formwork – Slip forms – Working platforms – Materials Hoist – Concrete pouring and pumping – General framing – Guardrails – Floor and roof openings – Lifting appliances – Fall protection.

UNIT - IV : TRUSS AND ROOF WORK (09)

Trusses – Instruction for truss installers, Truss erection – Roof work – Roof jacks and toe-holds (slide guards) Scaffolds – General provision – Guardrails, Toe boards for scaffolds – Erection requirements – Wood scaffolds erection guidelines – Other types of scaffolds, Ladder-jack scaffolds Trestle scaffolds, Shore and lean-to scaffolds, Suspended scaffolds, Rolling scaffolds.

UNIT – V : EQUIPMENT SAFETY (09)

Ladders Safety – General requirements – Job-built ladders, Stepladders – Portable tools – Hand tools, Pneumatic tools, Power tools-saws – Compressed air for cleaning – Pneumatic nailing and stapling equipment, Construction site hazards.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Allen St.John Hot, "Principles of Construction Safety", John Wiley & Sons, 2005.*
2. Mark Mc.Guire Moran, "Construction Safety Hand Book", 2003.
3. David Blockley, "Engineering Safety Hand Book", 1992.

Reference Books:

1. Grimaldi Simonds "Safety Management", AITBS Publishers, 2001.
2. V.J.Davies .K.Tomasin "Construction Safety Handbook", 1996.
3. John Schaufelberger "Construction Project Safety" Wiley Publications, 2013.

COURSE OUTCOME:

CO1: The students can obtain knowledge on safety measures to be taken during pre-construction work.

CO2: The students can able to follow the basic protective measures during construction.

CO3: The students can able to choose safety measure during concreting work.

CO4: The students can able to choose protective measures during truss and roof construction.

CO5: The students acquire knowledge on equipments needed for safety during construction.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L		L						M	L	H	L	M		L	M
CO2	L		L		L				M	M	H			M	H	L
CO3	L		L	L					M	M	H		L	M	H	L
CO4	L		L	L					M	M	H		L	H	M	L
CO5	L		L	L					M	M	H		M		L	L
16CPE005	L		L	L	L				M	M	H	L	L	M	H	L

L-Low, M-Moderate (Medium), H-High

16CPE006 **FINITE ELEMENT METHOD** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CBS3Z1 Engineering Mathematics - III
2. 16CBS401 Numerical Methods
3. 16CES303 Mechanics of Solids - I
4. 16CES402 Mechanics of Solids - II
5. 16CPC601 Structural Analysis - II

COURSE OBJECTIVES:

- To apprise the students about the basics of Finite Element theory, computer implementation of this theory and its practical applications.
- To learn about solid mechanics principles.
- To understand various basic energy and weighted residual methods.

UNIT - I : INTRODUCTION (09)

Concepts of Finite Element methods – Steps involved - Advantages & Disadvantages - Direct Stiffness Method - Steps in direct method of FEA - Problems on simple beams and Trusses - Discretization – Introduction to Finite Element Software packages.

UNIT – II : ELEMENTS OF ELASTICITY (09)

Introduction – Elastic Theory – Displacements and Strains – Equilibrium – Compatibility – Constitutive law – Plane Stress - Plane Strain- Basic principles of structural mechanics– Principles of Virtual work and minimum potential energy.

UNIT - III : FINITE ELEMENTS (09)

Concept of an element - Basic element shapes - Element properties - Displacement models – Approximation displacements by Polynomials - Convergence requirements – Generalised co-ordinates – Natural co-ordinates – Shape functions for linear & quadratic models – Stiffness matrix – Nodal load vector – Static condensation – Simple problems.

UNIT – IV : INTRODUCTION TO ISOPARAMETRIC ELEMENTS (09)

Concept of sub, iso, super parametric elements – Gauss quadrature – Examples in one and two dimensional elements – Stress analysis of three Dimensional elements.

UNIT – V : SOLUTION TECHNIQUES (09)

Different solvers – Variational approach – Weighted mean residual methods like Collocation method, Subdomainmethod, Galerkin method and Least square method – Simple problems only.

CONTACT PERIODS:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *Krishnamoorthy C.S., "Finite Element Analysis- Theory and Programming, Second Edition. Tata McGraw Hill Publishing Co., 2004.*

2. Tirupathi R. Chandrupatla and Ashok D. Belugundu, "Introduction to Finite Elements in Engineering, Third Edition.", Prentice Hall India Pvt Ltd, 2011.

3. P.Seshu, "Textbook of Finite Element Analysis", Prentice Hall India Pvt Ltd, 2008.

Reference Books:

1. Cook Robert. D, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, INC,1995.

2. Rajasekaran.S., "Finite Element Analysis in Engineering Design", Wheeler Publishing,2000.

3. S.S.Rao, "The Finite Element Method in Engineering", Buttersworth - Heinemann publishing, 2000.

COURSE OUTCOME:

CO1: Familiarize the basic concepts involved in FEM theory and to solve problems of one-dimensional elements (truss and beam).

CO2: To recognize the basic principles of structural mechanics and to apply the concepts on simple structural elements.

CO3: To familiarize about the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation (for 1D, 2D and 3D Problems).

CO4: Familiarize the formulation of isoparametric elements.

CO5: Deriving finite element equations using direct and formal (basic energy and weighted residual) methods.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		M					H		H						
CO2	H	M	M					H		H				M	M	
CO3	H	M	M	M		L		H		H				L	M	M
CO4	H	M	H			H		H		H				M	L	L
CO5	H	H	H			H		H		H				M	M	M
16CPE006	H	M	M	M		H		H		H				M	M	M

L-Low, M-Moderate (Medium), H-High

16CPE007 **ADVANCED CONCRETE DESIGN** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CPC502 Basic Structural Design - II (Concrete)**
2. **16CPC703 Concrete Structures**

COURSE OBJECTIVES:

- To create an awareness on yield line theory of slabs.
- To understand the design principles of Grid floors, ribbed slabs and bunkers and silos.
- To understand the design of slender columns, RC walls, bridges, corbels and deep beams.

UNIT - I : YIELD LINE THEORY OF SLABS AND INELASTIC BEHAVIOUR OF CONCRETE BEAMS **(09)**

Yield line theory- Assumptions made in analysis – analysis of isotropically and orthotropic ally reinforced slabs for various shapes and different edge conditions by virtual work method and equilibrium method – design by limit state method. Inelastic behaviour of concrete beams, moment rotation curves, moment redistribution.

UNIT – II : DESIGN OF SPECIAL RC ELEMENTS **(09)**

Design of slender columns – Braced and Unbraced – design considerations of RC walls – design of deep beams.

UNIT - III : GRID FLOORS AND RIBBED SLABS **(09)**

Grid floors – design principles – analysis of grid floor by approximate method – detailing of steel in flat grids. Ribbed slabs – analysis and design of slab for moment and shear.

UNIT – IV : BUNKERS AND SILOS **(09)**

Design of Bunkers – Design of Silo - Detailing of reinforcements.

UNIT – V : DESIGN OF BRIDGES **(09)**

Types of bridges – IRC loadings – Design of single span slab bridge deck for class A loading – Design of T– beam bridge for class AA loading.

CONTACT PERIODS:
Lecture: 45 Periods **Tutorial:0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *Varghese.P.C, "Advanced Reinforced concrete design", Prentice Hall of India Private Ltd, NewDelhi, 2009.*
2. *Krishna raju, "Advanced reinforced concrete design – S.I units", C.B.S., New Delhi, 2006.*

Reference Books:

1. IS 456-2000, "Indian standard code of practice for plain and reinforced concrete".
2. SP 34(1987), "Handbook on Concrete Reinforcement and Detailing", BIS, New Delhi.
3. IRC 6 – 2014, Standard Specifications and Code of Practice for Road Bridges
4. Purushothaman,P., "Reinforced concrete structural Elements", Tata McGraw Hill, NewDelhi,2002.
5. Ashok. K.Jain., "Reinforced concrete- Limit state design", NemChand Bros, Roorkee, 2000.
6. Sinha. S.N., "Reinforced Concrete Design", Tata McGraw Hill, New Delhi, 2003.
7. Pillai S. U. and Menon, D., "Reinforced Concrete Design", Tata McGraw Hill, 2003.
8. Shah V.L and Karve S.R, "Limit State Theory and Design of Reinforced Concrete", Structures Publications, 2014.
9. Syal I.C. and Goel A.K., "Reinforced Concrete Structures", A.H.Wheeler &Co., 2004.

COURSE OUTCOME:

CO1: Able to analyze slabs using yield line theory.

CO2: Able to design of slender columns, RC walls, and deep beams.

CO3: Able to design Grid floors, ribbed slabs.

CO4: Able to design bunkers and silos.

CO5: Able to design bridges.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M		M				H					L	H	M	
CO2	H	M		M				H					L	H	M	
CO3	H	M		M				H					L	H	M	
CO4	H	M		M				H					L	H	M	
CO5	H	M		M				H					L	H	M	
16CPE007	H	M		M				H					L	H	M	

L-Low, M-Moderate (Medium), H-High

16CPE008 **BASICS OF DYNAMICS AND ASEISMIC DESIGN OF STRUCTURES**

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC501 Structural Analysis - I
2. 16CPC601 Structural Analysis - II

COURSE OBJECTIVES:

- To learn the basics of various dynamic forces and its effects on the structure.
- To enhance the ability to identify the mode shapes of the structure under dynamic loading.
- To learn the causes and effects of earthquake and its measurement.
- To enhance the ability to design an earthquake resistant structures by using IS codal provisions.

UNIT - I : THEORY OF VIBRATIONS (09)

Concept of inertia and damping – Types of damping – Difference between static forces and dynamic excitation –degrees of freedom – SDOF idealization – Equations of motion of SDOF system of mass as well as base excitation –Free vibration of SODF system – response to harmonic excitation – Impulse and response to unit impulse–Duhamel integral.

UNIT – II : MULTIPLE DEGREE OF FREEDOM SYSTEM (09)

Two degree of freedom system – Normal modes of vibration – Natural frequencies – Mode shapes – Introduction to MODF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).

UNIT - III : ELEMENTS OF SEISMOLOGY AND SEISMIC DESIGN CONCEPT (09)

Grid floors – design principles – analysis of grid floor by approximate method – detailing of steel in flat grids. Ribbed slabs – analysis and design of slab for moment and shear. Causes of earthquake – Geological faults – tectonic plate theory –Elastic rebound – Epicentre – Hypocentre – primary, shear and Raleigh waves – seismogram – magnitude and intensity of earthquake – magnitude and intensity scales– Spectral acceleration – Information on some disastrous earthquakes – concept of earthquake resistant design –strong column weak beam concept – guide lines for seismic resistant construction – effects of structural irregularities – seismo resistant building architecture.

UNIT – IV : RESPONSE OF STRUCTURES TO EARTHQUAKES (09)

Response and design spectra –Design earthquake – concept of peak acceleration – Site specific response spectrum –Effect of soil properties and damping – Liquefaction of soils – Importance of ductility – Methods of introducing ductility into RC structures.

UNIT – V : DESIGN METHODOLOGY (09)

IS 1893, IS 13920 and IS 4326 – Codal provisions – design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquakes on structures.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Chopra, A.K., "Dynamics of structures – Theory and Applications to Earthquake Engineering, Second Edition", Pearson Education, 2005.*
2. *Pankaj Agarwal & Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, New Delhi, 2009.*
3. *S.K.Duggal, "Earth Quake Resistant Design of Structures", Oxford university Press, 2012.*

Reference Books:

1. Bruce A Bolt, "Earthquakes" W H Freeman and Company, New York, 2004.
2. C. A. Brebbia,"Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
3. Indian Standard Codes: IS: 1893, IS: 4326 and IS:13920, Bureau of Indian Standards, New Delhi.

COURSE OUTCOME:

CO1: The student will be able to understand the theory of vibrations and determine response of structures.

CO2: The students will be able to analyse the causes and effects of earthquake.

CO3: The students will be able to plan the structures which can overcome earthquake forces.

CO4: The students will be able to apply Indian codal provisions in the planning, design and detailing of structures.

CO5: The students will be able to execute vibration control techniques in various structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1			L	L		M	L	M				M	M			
CO2		H	M			H		L							H	
CO3			M			H		H							H	L
CO4			H			H	L	H							M	M
CO5			H	L								L	L		M	
16CPE008		H	H	L		H	L	H				M	M		H	M

L-Low, M-Moderate (Medium), H-High

16CPE009 **PAVEMENT ENGINEERING** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

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

UNIT - I : BASIC CONCEPTS (09)

Pavement – Types and components – Comparison – Function of components – Factors affecting design and performance of pavements – Vehicle and traffic factors – Design wheel load – Maximum wheel load –contact pressure – ESWL – Repetition of loads – Stresses and deflections in homogeneous masses.

UNIT – II : FLEXIBLE PAVEMENT (09)

Various approaches of design – Empirical, Semi-empirical and theoretical methods – IRC design guidelines – Applications of different pavement design methods.

UNIT - III : RIGID PAVEMENT (09)

Stresses in rigid pavement – Evaluation –IRC design guidelines– Types of joints and their functions– Design of joints.

UNIT - IV : QUALITY CONTROL (09)

Field compaction – Rammers – Rollers – Compaction control – Insitu density –pavement materials - Bitumen – Ductility– Viscosity – Binder content and Softening point tests – Aggregate – Crushing – Abrasion – Impact Tests – Water absorption – Flakiness and Elongation indices.

UNIT – V : EVALUATION AND REHABILITATION (09)

Distress in flexible and rigid pavements – Pavement evaluation – Present Serviceability Index – Structural evaluation – Evaluation by deflection measurements – Strengthening of pavements – Flexible and rigid overlays.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Yoder, R.J and Witchak, M.W, "Principles of Pavement Design", John wiley, 2000.*
2. Yang, "Design of functional Pavements", McGraw Hill Publishing Company, 2004.
3. Khanna, S.K and Justo C.E.G, "Highway Engineering", New Chand and Brothers, Roorkee, 2002.

Reference Books:

1. *Kadiyali, L.R., "Transport planning & Traffic Engineering" Khanna Publishers, 2003.*
2. *S.K Sharma, "Principles, Practice and Design of Highway Engineering" S. Chand & Co., Ltd., New Delhi, 1985.*
3. *Design and specification of Rural Roads (Manual), Ministry of rural roads, Government of India, NewDelhi,2001.*
4. *Guidelines for the Design of Flexile Pavements, IRC: 37-2012, The Indian roads congress, New Delhi.*
5. *Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC: 58-2002, The Indian Roads Congress, New Delhi.*

COURSE OUTCOME:

CO1: The students will learn the types and components of pavements and stresses in flexible pavement.

CO2: Students learn to use different methods for designing flexible pavements.

CO3: Students understand the stresses and use of IRC guidelines for design of rigid pavement.

CO4: Students will have adequate knowledge on the various quality control tests.

CO5: The students will also learn about the evaluation of pavements and strengthening methods.

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COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	M		M	M	M			L	M	L	H	H		L
CO2			H	M	H		M	L	H	H	H			H	H	H
CO3	H		H			M			H			M		H		
CO4		H		M	H			L	H	H				H	H	H
CO5	H				H	M	H		H		H	M		H	H	
16CPE009	H	H	H	M	H	M	M	L	H	H	H	M	H	H	H	H

L-Low, M-Moderate (Medium), H-High

16CPE010 INDUSTRIAL WASTEWATER MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CPC506 Wastewater Engineering**

COURSE OBJECTIVES:

* To impart knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control.

UNIT - I : INTRODUCTION (09)

Effects of Industrial Wastes on Streams, Land and wastewater Treatment Plants – water quality criteria – Effluent standards – Industrial effluent - volume reduction – Strength reduction – Process Modification - Methods and Materials changes - Housekeeping – established recovery and reuse methods for byproducts within the plant operations – Regularity requirements and Environmental legislations.

UNIT – II : INDUSTRIAL EFFLUENT TREATMENT (09)

Equalization and Neutralization – separation of Solids - Physio-chemical treatment – Removal of organic and inorganic solids – combined treatment of Industrial and municipal Wastes - Individual and Common Effluent Treatment Plants. Biological treatment methods – Aerobic and Anaerobic digestion – Ultimate disposal of sludge – Cleaner Technologies and pollution prevention – Waste minimization – Management of RO rejects.

UNIT - III : ADVANCED WASTEWATER TREATMENT, REUSE AND RESIDUE MANAGEMENT (09)

Chemical Oxidation - Ozonation - Photocatalysis - Wet Air Oxidation - Evaporation - Ion exchange – Membrane technologies - Nutrient removal - Land treatment – Well injection. Quantification and characteristics of sludge -thickening, Digestion, Wet combustion - Conditioning, Dewatering and Disposal of Sludge.

UNIT - IV : CASE STUDIES – 1 (09)

Industrial manufacturing process description, wastewater characteristics and effluent treatment flow sheet for Textiles, Sugar mill, distilleries, Thermal power plant, Nuclear power plant, Petroleum refineries, Fertilizers and Dairy.

UNIT – V : CASE STUDIES – 2 (09)

Industrial manufacturing process description, wastewater characteristics and effluent treatment flow sheet for Tanneries, Pulp and Paper mill, Chemical industries, Metal finishing industries, Iron and Steel industries, Meatpacking industries and Poultry plant - Industrial estates and Industrial Clusters.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *M. Narayana Rao and Amal K. Dutta, "Wastewater Treatment", Oxford & IBH Publishing Co., Pvt.Ltd., New Delhi, 2001.*
2. *D. Barnes, P. J. Buss and B. W. Gould, "Water and Wastewater Systems", Pitman Publishing Inc., Marshfield, 2000.*

Reference Books:

1. *Nemerow N. L., "Industrial Water Pollution", Addison - Wesley Publishing Company Inc.,USA, 1978.*
2. *Wesley Eckenfelder Jr. W, "Industrial water pollution control", McGraw Hill book Co, New Delhi, 2001.*
3. *Mahajan S. P. "Pollution Control in process industries", Tata McGraw Hill Publishing Co Ltd., New Delhi,1989.*
4. *"Pollution Prevention and Abatement Handbook Towards Cleaner Production" The World Bank Group, Washington, D. C., 1998.*

COURSE OUTCOME:

CO1: Students are exposed to the effects of waste, effluent standards, recovery and reuse methods and various environmental legislations.

CO2: Able learn Physical Chemical and Biological Treatments.

CO3: Students will know about the advanced waste water treatment processes.

CO4: Able to get Knowledge about Pollution from major industries and treatment Technologies

CO5: Able to learn through Case studies of industrial units with its manufacturing and effluent treatment flow sheets.

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COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L			L	L		L		L		L		L	H		L
CO2	M			L			M		L	M		L	L	H	M	L
CO3	M			L			M		L	M		L	L	H	M	L
CO4	L	L		M			M		L		L		L	H		L
CO5	L	L		M			M		L		L		L	H		L
16CPE010	L	L		L	L		M		L	M	L	L	L	H	M	L

L-Low, M-Moderate (Medium), H-High

16CPE011 AIRPORT, DOCKS AND HARBOUR ENGINEERING **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To expose the students to design principles of Airports and Harbours.

UNIT - I : AIRPORTS (09)

Air transport-development in India and importants in national transportation sector-airport planning and site selection for landing and terminal areas – layout of their components and locational requirements- airport classification- design standards of airports.

UNIT – II : AIRPORT COMPONENTS AND DRAINAGE (09)

Runways – Orientation – types, pattern layout- basic runway length-runway design – orientation, geometric design and corrections- Taxiways and apron - general principles of design, layout, construction and maintenance terminal area- terminal buildings, hangers and auxiliary structures. Airport drainage- various types, materials and construction features- airport marking and lighting.

UNIT - III : DOCKS AND HARBOUR (09)

Historical development of docks, harbours and seaports- Basic definition - Requirements and classification- recent trends in seaport planning and construction including container and special purpose terminals- inland water transport. Types of wet and dry docks- their functional design and usage.

UNIT - IV : BREAK WATER AND QUAYS (09)

Types, uses and general construction methods of break water- layout and construction of quays and jetties and wharves.

UNIT – V : NAVIGATIONAL AIDS AND DREDGING (09)

Necessity and types of signals including floating signals – buoys and beacons- mooring and mooring accessories – Types of dredging and its application – Cargo handling.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Khanna.S.K and Arora.M.G., "Airport planning and design", S.Chand and bros, 2006.*
2. *Vazirani.V.N and Chandola.S.P., "Transportation and Engineering, Vol.2", Khanna publishers, New Delhi,2005.*

Reference Books:

1. Shahani .P.B, "Airport techniques", second edition- Oxford publishing, NewDelhi, 1990.
2. Srinivasan.R., "Harbour, Dock and Tunnel Engineering", Chartor publishing house, Anand, India,2004.

COURSE OUTCOME:

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

CO1: Know various components of an airport.

CO2: Understand design of runway and lighting pattern.

CO3: Know various components of a harbor and their functions.

CO4: Understand break water construction methods.

CO5: Understand types and functions of navigational lights.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M													L		
CO2		M	L						H						M	
CO3	L													L		
CO4		M	L						M				L			
CO5	L															L
16CPE011	L	M	L						H				L	L	M	L

L-Low, M-Moderate (Medium), H-High

16CPE012 **HYDROLOGY** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC503 Water Resources Engineering

COURSE OBJECTIVES:

- To impart knowledge on hydrological cycle, spatial and temporal measurement and analysis of rainfall and their applications including flood routing and ground water hydrology.

UNIT - I : HYDROMETEOROLOGY (09)

Hydrological cycle – Hydrometeorological factors – Cloud formation – Winds and their movement – Types of precipitation– Forms of precipitation – Density and Adequacy of rain gauges – Recording and non - recording rain gauges – Optimum number of rain gauges.

UNIT – II : PRECIPITATION AND ABSTRACTIONS (09)

Spatial distribution – Consistency analysis – Frequency analysis – Intensity, duration, frequency relationships – Evaporation– Infiltration – Horton's equation – Infiltration indices – measurement of infiltration – abstraction loss.

UNIT - III : HYDROGRAPH ANALYSIS (09)

Flood Hydrograph – Components of flood hydrograph – Factors affecting shape of Hydrograph - Base flow separation– Unit hydrograph – Advantages – Instantaneous Unit hydrograph - S curve Hydrograph - Synthetic unit hydrograph –Applications.

UNIT - IV : GROUND WATER HYDROLOGY (09)

Occurrence of ground water – Types of aquifer – Dupuit's assumptions – Darcy's law – Estimation of aquifer parameters – Pump tests – Steady and unsteady state conditions - Discharge in a Confined and Unconfined Aquifers – Leaky aquifer – well loss – aquifer loss– problems.

UNIT – V : FLOOD ANALYSIS (09)

Flood estimation – Gumbel's method – Log Pearson type III method – Reservoir flood routing – Channel routing – Types of streams – Stage discharge relationships - Flow measurements – Current meter method for velocity measurements.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Santosh Kumar Garg, "Hydrology and Water Resources Engineering", Khanna Publications Pvt. Ltd., NewDelhi, 2009.*
2. Jayaramy Reddy. P., "Hydrology", Tata McGraw-Hill Publications Pvt.Ltd, New Delhi, 2003.

Reference Books:

1. Subramanya. K., "Engineering Hydrology", Tata McGraw-Hill Publications Pvt.Ltd, New Delhi, 2002.
2. Warren Viessman and Gary L. Lewis, "Introduction to Hydrology", Prentice Hall of India Pvt.Ltd, New Delhi, 2003.

COURSE OUTCOME:

CO1: The students would obtain knowledge on behavior of water molecules in atmosphere.

CO2: The students are able to present the meteorological data for forecasting.

CO3: The students are able to understand the importance of hydrographs.

CO4: The students would obtain the knowledge on the design of well system.

CO5: The students are able to predict the future floods and identify their routing.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M		L		L			L					H	L	M
CO2	H			M			L			L	M			M	L	H
CO3	L	M					L	L			H	M		H	M	L
CO4	L	H		H	L		H		L	M			L	H	M	L
CO5	M			L	L	M			M	M	L			M	L	
16CPE012	M	M		L	L	M	L	L	L	M	H	M	L	H	L	L

L-Low, M-Moderate (Medium), H-High

16CPE013 PERIMENTAL STRESS ANALYSIS Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CES303 Mechanics of Solids - I

COURSE OBJECTIVES:

- To familiarize about various types of strain gauges and measuring instruments.
- To understand the behaviour of structural elements using various techniques.
- To know about the concepts of model analysis.

UNIT - I : STRAIN MEASUREMENT METHODS (09)

Strain gauges – basic characteristics –Types - working principles – Strain rosettes – Calculation of principal strains and principal stresses.

UNIT – II : MEASURING INSTRUMENTS (09)

Linear Variable Differential Transducer – Cathode Ray Oscilloscope – XY Plotter – Digital Data Acquisition System – Hydraulic Jacks – load cells – Proving Rings – Vibration meter – Wind Tunnel – Calibration of Testing Instruments.

UNIT - III : PHOTO ELASTICITY (09)

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

UNIT – IV : MODEL ANALYSIS (09)

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 (09)

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

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Sadhu Singh, "Experimental stress analysis", Khanna Publishers, New Delhi, 2009.*
2. *Dally and Railey, "Experimental stress analysis", McGraw-Hill, 2003.*

Reference Books:

1. *Bray and Stanley, "Non Destructive Evaluation", McGraw Hill Publishing co., New York, 1996.*
2. *Richard G Budynas, "Advanced Strength and Applied Stress Analysis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2011.*
3. *Dove and Adam,"Experimental stress analysis and Motion measurements", 1989.*
4. *Srinath L.S., "Experimental stress Analysis", Tata McGraw Hill company Book Ltd., NewDelhi, 1984.*

COURSE OUTCOME:

CO1: Able to describe the working principles of various stain gauges and calculation of stresses using strain rosettes.

CO2: Able to demonstrate about various measuring instruments.

CO3: Able to explain about two dimensional photo elasticity and its applications.

CO4: Able to apply laws of similitude for model analysis.

CO5: Able to adopt advanced techniques for stress analysis.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L	M	H		M		L		M	L			L	M	M
CO2	M	L	M	H		M		L		M	L			L	M	M
CO3	M	L	M	H		M		L		M	L			L	M	M
CO4	M	L	M	H		M		L		M	L			L	M	M
CO5	M	L	M	H		M		L		M	L			L	M	M
16CPE013	M	L	M	H		M		L		M	L			L	M	M

L-Low, M-Moderate (Medium), H-High

16CPE014 GEOTECHNICAL EARTHQUAKE ENGINEERING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC505 Mechanics of Soils
2. 16CPC702 Foundation Engineering

COURSE OBJECTIVES:

* To understand the dynamics of earth and to estimate dynamic properties of soils.
* To develop the site specific design spectrum for design of sub structure and evaluation of liquefaction potential.

UNIT – I : ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMICS (09)

Mechanism of Earthquakes – Causes of earthquake – Earthquake Fault sources – Elastic Rebound theory – Seismicwave in Earthquake shaking – Definition of earthquake terms – Locating an earthquake – Quantification of earthquakes.

UNIT – II : GROUND MOTION CHARACTERISTICS (09)

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

UNIT - III : GROUND RESPONSE ANALYSIS - LOCAL SITE EFFECTS AND DESIGN GROUND MOTION (09)

Wave propagation Analysis – Site Amplification – Need for Ground Response Analysis – Shear Beam analysis – Methods of analysis – One Dimensional Analysis – Equivalent linear Analysis – Effects of local site conditions on ground motion –Developing Design Ground Motion-Codal Recommendations.

UNIT - IV : SEISMIC STABILITY ANALYSIS (09)

Earthquake resistant design of foundation– 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 recommendations.

UNIT – V : EARTHQUAKE HAZARD MITIGATION (09)

Seismic risk vulnerability and hazard – Percept of risk – Risk mapping – Hazard assessment – Mitigation measures–Different type of foundation and its impact on safety – Soil improvement for remediation of seismic hazards.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *KameswaraRao, N.S.V., "Dynamics soil tests and applications", WhellerPublishing , New Delhi, 2000.*
2. *Krammer S.L., "Geotechnical Earthquake Engineering", Prentice hall, International series Pearson Education (Singapore) Pvt. Ltd., 2004.*

Reference Books:

1. Robert W. Day,"Geotechnical Earthquake Engineering Handbook", McGraw Hill,2002.
2. IsiharaKenji, "SoilBehaviour in Earthquake Geotechnics", Oxford University press, 1996.

COURSE OUTCOME:

CO1: Students will be able to explain the mechanism and fundamentals of earthquake.

CO2: Able to understand the ground response analysis and to estimate dynamic properties of soil.

CO3: Students will get thorough knowledge to analyse ground motion by different methods.

CO4: Students can perform stability analysis and earthquake design of foundations

CO5: Able to estimate seismic hazards and to prepare risk mapping.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H		H					H	L	L	M		H	H		H
CO2	M	H	M	M			L		H					H		
CO3	M				H	L	H			M	M			H		
CO4		M		H	H				H					H	H	
CO5			H			H	H		H			H		H	H	
16CPE014	M	H	H	H	H	H	H	H	H	M	M	H	H	H	H	

L-Low, M-Moderate (Medium), H-High

16CPE015 **BRIDGE ENGINEERING** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16CPC502 Basic Structural Design – II (Concrete)

COURSE OBJECTIVES:

- To make the students aware of types of bridges, principles, design and design procedure of various bridge structures.

UNIT - I : INTRODUCTION (09)

Components of a bridge structure – inspection and site investigations for a bridge – Determination of linear waterway, design discharge and scour depth – Economical span – Types and choice of bridges. IRC loading classifications – simple problems.

UNIT – II : SLAB BRIDGE (09)

Slab Bridge - Distribution of concentrated loads by IRC and Pigeaud's Method – Design of tee beam bridge – design of main girder– Design of cross girders – Load distribution by Courbon's Method – Skew slab Bridge.

UNIT - III : BRIDGE & CULVERT (09)

Single span rigid frame bridge (barrel or slab type only) – box culvert (single vent only). Balanced cantilever RC bridges– Design of articulations.

UNIT - IV : MODERN BRIDGES (09)

Temporary and movable bridges. RC Arch bridge (open spandrel and string girder type only) – Cable stayed bridges –Suspension bridges – design principles only.

UNIT – V : BEARING, SUBSTRUCTURE AND REBUILDING OF STRUCTURES (09)

Bearings – types, functions – simple problems – substructures – abutment, pier – materials-stability requirements -Rebuilding of bridges – replacement – pier tops – girders – side sleeving and end launching methods – Joints in bridges.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Jhonson Victor .D., "Bridge Engineering", Oxford & IBH publishing Co., Ltd, New Delhi, 2003.*
2. Ponnuswamy.S, "Bridge Engineering", Tata McGraw Hill Publishing Co., Ltd, New Delhi, 2001.
3. Jagadeesh and Jeyaram, "Design of Bridge Structures", Prentice Hall of India, 2011.

Reference Books:

1. Vazirani V.N., Ratwani M.M., & Vaswani, "Bridge Engineering", Khanna publishers, 2000.
2. Bindra S.P., "Principles and practice of Bridge Engineering", Dhanpat Rai & Sons, New Delhi,1995.
3. Krishnaraju," Design of bridges", New age international publishing ltd, Newdelhi, 2005.

COURSE OUTCOME:

At the end of the course the students shall / will be able to

CO1: Know components of bridges and understand economical span.

CO2: Understand, design of slab bridge by Pigeaud's method load distribution.

CO3: Understand principles and procedure of rigid frame and balanced cantilever bridges.

CO4: Know design principles of modern bridges.

CO5: Know design of sub structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H													L		
CO2			L						H						H	
CO3		L		L										L		
CO4				L												L
CO5			L						M						M	
16CPE015	H	L	L	L					H					L	H	L

L-Low, M-Moderate (Medium), H-High

16CPE016 TRAFFIC ENGINEERING AND MANAGEMENT Category: PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT - I : INTRODUCTION (09)

Scope– Properties of traffic engineering elements – vehicle, driver and road characteristics - skid resistance and breaking efficiency – simple problems. Components of traffic Engineering – control mechanisms.

UNIT – II : TRAFFIC SURVEYS (09)

Surveys – Classification - Volume, Speed and delay, origin and destination - parking, accidents – stastical methods for traffic engineering – simple problems – analysis-capacity of roads-level of service – interpretation of traffic studies and conclusions.

UNIT – III : TRAFFIC CONTROL (09)

Traffic signs – location and design recommendations - Road markings – Classification and design of traffic signals –signal co-ordination – Traffic islands and rotaries – Traffic control aids and street furniture – Regulation of traffic –Modern methods of traffic control.

UNIT – IV : TRAFFIC SAFETY AND MANAGEMENT (09)

Road accidents – types - causes and prevention with emphasis on engineering factors – Traffic management, Transport system management (TSM) and Transport Demand Management (TDM), restrictions on turning movements, one way streets, traffic segregation, tidal flow operation, exclusive bus lanes and other management measures – introduction to intelligent transport systems (ITS).

UNIT – V : TRAFFIC MANAGEMENT PROJECTS (09)

Design of parking facilities, on street and off street parking – case studies on area traffic management – street lighting –noise and air pollution abatement – Basis of comprehensive traffic and transport studies – intersection improvements including design of roundabouts.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Kadiyali.L.R, "Traffic Engineering and Transport planning", Khanna Publishers, 2011.*
2. *Salter.R.I., and Hounsell.N.B, "Highway Traffic Analysis and Design", Macmillan Press Ltd., 2000.*

Reference Books:

1. *Manual of Transportation Engineering studies, Institution of Transportation Engineering, Prentice hall Publications, 1994.*
2. *John.E.Tyworth., "Traffic Management Planning", Operation and Control, Addison Wesley Publishing Company, 1997.*

COURSE OUTCOME:

At the end of the course the students shall / will be able to

CO1: Understand traffic elements and their characteristics.

CO2: Understand and conduct various traffic surveys.

CO3: Understand design of traffic signals.

CO4: Analyse the causes of road accidents and take controlling measures.

CO5: Design of parking facilities, clower leaf intersection and traffic rotary.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M													L		
CO2		H													L	
CO3										H				M		
CO4				M												L
CO5											L				L	
16CPE016	M	H		M						H	L			M	L	L

L-Low, M-Moderate (Medium), H-High

16CPE017 GROUND IMPROVEMENT TECHNIQUES Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CPC505 Mechanics of Soils**

COURSE OBJECTIVES:

* At the end of the course student is expected to identify the problematic soil and suitable suggest remedial measures to improve their behavior.

UNIT - I : DEWATERING (09)

Scope and necessity of ground improvement – Methods of ground improvement – Selection based on soil conditions – Dewatering by well point system – Deep well-Vacuum and Electro - Osmotic method.

UNIT – II : COMPACTION AND SAND DRAINS (09)

In-situ densification of granular and consolidation of cohesive soils – Shallow and deep compaction – Vibration methods – Vibrocompaction, Blasting, Vibroflotation – Factors influencing compaction – Heavy Tamping – Vertical drains – Preloading with sand drains, Fabric drains, Wick drains –Relative merits and limitations of different methods.

UNIT - III : STONE COLUMN AND CONSOLIDATION (09)

Stone columns and lime piles – Construction methods – merits and demerits – Precompression and consolidation – Dynamic consolidation – Electro-osmotic consolidation -Earth reinforcement – types and applications of geosynthetics – filtration – drainage – separation – reinforcement – Soil Nailing.

UNIT – IV : SOIL STABILIZATION (09)

Stabilization methods – Mechanical, Chemical stabilisation-Cement, Lime, Bitumen – Electro - kinetic stabilization – Stabilization of expansive clays.

UNIT – V : GROUTING (09)

Types of grout – Suspension and solution grouts –Basic requirements – Displacement grouting – Compaction grouting – Permeation grouting – Grouting equipment and methods – Grout monitoring schemes.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Purushothama Raj, P., "Ground Improvement Techniques", Laxmi Publications (P) Ltd., New Delhi, 2005.*
2. *Nihar RanjanPatra., "Ground Improvement Techniques", Vikas publishing House Pvt. Ltd.,2012.*

Reference Books:

1. *Moseley M.P., "Ground Treatment, Blackie Academic and Professional", 1998.*
2. *Shroff, A.V., "Grouting Technology, in Tunneling and Dam", Oxford & IBH Publishing Co. Pvt. Ltd., NewDelhi, 1999.*
3. *Koerner, R.M., "Designing with Geosynthetics (fourth edition)", Prentice Hall, New Jersey, 1999.*
4. *Hausmann, M.R., "Engineering principles of Ground modification", McGraw Hill,1990.*

COURSE OUTCOME:

CO1: To understand the selection of suitable ground improvement techniques and different dewatering techniques.

CO2: The students acquire knowledge on the various insitu treatment of cohesionless and cohesive soils.

CO3: Students understand the constructional aspects of stone column and earth reinforcement.

CO4: Students will be able to identify and implement suitable stabilization methods.

CO5: Students will be able to select and apply different grouting techniques.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H			M	H			L				H	H	
CO2				H				H	H	L			H	H		
CO3	M	H			M	M			H	H	M			H	H	
CO4	M		H					H			L			H		
CO5	M	H	H						H				H	H	H	
16CPE017	M	H	H	H	M	M	H	H	H	L	M		H	H	H	

L-Low, M-Moderate (Medium), H-High

16CPE018 PREFABRICATED STRUCTURES Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To impart knowledge to students on modular construction, industrialized construction and design of prefabricated elements and construction methods.

UNIT - I : INTRODUCTION (09)

Prefabrication- Need of prefabrication - Comparison with monolithic construction – Advantages and Disadvantages - Methods of prefabrication – site and plant prefabrication – Types of precast systems - Modular coordination – Standardization- Tolerance.

Precast concrete – Materials-Cement, SCM, Aggregate, Water, Chemical Admixtures, Pigments, reinforcement, Prestressing Tendons, Concrete and properties, Grout and mortars.

UNIT – II : PREFABRICATED COMPONENTS (09)

Beams-Columns- Roof units- Floor units- wall panels – footings-Dimensions of prefabricated elements.

UNIT - III : PRODUCTION TECHNOLOGY (09)

Choice and planning of production setup – Manufacturing methods – Production process-Moulds – Acceleration of concrete hardening, Curing.

UNIT - IV : ANALYSIS, DESIGN AND JOINTS IN STRUCTURAL MEMBERS (09)

Loads-Load combination, - Disuniting of structures- Analysis of precast frames- Design of inverted Tee beam and L beam Connection in precast building – Column to foundation connections, Wall panel to foundation connections, Beam to Column Connections, Column to column Connections, Floor to Beam Connections, Wall panel to Wall Panel Connection

UNIT – V : HANDLING AND ERECTION (09)

Storage of precast elements - Equipments for hoisting and erection –Installation of precast element – Colun, Wall, Beam, Slab – Transportation- Handling Equipments and Handling Devices - Vacuum lifting pads.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *L. Mokk, "Prefabricated Concrete for Industrial and Public Structures", Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.*
2. *K.M. Elliott, "Precast concrete structures", Butterworth Heinmann, 2002.*

Reference Books:

1. *CBRI, "Building materials and components", India, 1990.*
2. *Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994.*
3. *B. Lewicki, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam, London, NewYork, 1998.*
4. *Structural Design Manual, "Precast Concrete Connection Details", Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.*
5. *I. T. Koncz, "Manual of Precast Concrete Construction", Vol. I, II, III & IV, Berlin, 1971.*
6. *Handbook on precast concrete for buildings ICI BULLETIN 02.*
7. *Ganesan and latha "Prefabricated structures", sree kamalamani publications, Chennai 2014.*

COURSE OUTCOME:

CO1: Students will be able to understand the need of prefabricated structures and materials.

CO2: Students will be gain knowledge on the prefabricated components.

CO3: Students will understand production process and methods of prefabricated elements.

CO4: Students will be analysis, design of members and connections of precast building.

CO5: Students will get idea on handling and installation of elements.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	L		M			M	H			M	M	M	H		L
CO2	L	L		M		M	L	H		H	L	L	L	H	L	
CO3	H	L	L	M	L	L	L	L	L	M	L	L		H	L	L
CO4	L	L	H	H		M			L					H	M	
CO5	L		H			H	L	M	L	L		L		H		L
16CPE018	L	L	H	M	L	M	L	H	L	H	L	L	M	H	L	L

L-Low, M-Moderate (Medium), H-High

16CPE019 **HIGHWAY ENGINEERING** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. **16CPC305 Surveying – I**
2. **16CPC405 Surveying – II**

COURSE OBJECTIVES:

* To give an overview about the highway engineering with respect to, planning, design, construction, operation and maintenance of highways as per IRC standards, specifications and methods.

UNIT - I : HIGHWAY PLANNING & FINANCING (09)

Importance of Highway Transportation– Classification of Highways- Scope, advantages and important highway plans – Various organisation – IRC, CRRI, HRB – Highway financing – Calculation of Annual cost – Economic analysis –methods- Highway location and surveys – MORTH Specifications.

UNIT – II : GEOMETRIC DESIGN OF HIGHWAYS (09)

Introduction –Design Parameters-PCU, Design Vehicle, speed, gradient, Camber, super elevation,- Typical cross sections, Sight distance- Types-Horizontal & Vertical alignment- Design of curves – curve widening- Intersections- problems.

UNIT - III : HIGHWAY MATERIALS AND CONSTRUCTION (09)

Testing of Highway materials – Tests on soils, aggregates and Bitumen – CBR Test - Equipments used in Highway construction – Stages of highway construction – Soil stabilization – Bituminous pavement construction – Water bound Macadam roads – Cement concrete pavement construction.
Use of Plastic – Waste materials in road construction.

UNIT - IV : FLEXIBLE & RIGID PAVEMENTS (09)

General principles – Factors affecting pavement stability – ESWL, Sub grade soil, traffic - Flexible pavement design methods – Empirical methods – IRC 37: 2012 Procedure – Rigid pavement design methods – Stress in concrete pavement – Westergaard analysis – Types of rigid pavements – Design of pavement thickness – Design of joints.

UNIT – V : PAVEMENT EVALUATION AND MAINTENANCE (09)

Structural evaluation – Lab and field test methods – Strengthening of pavements – Types of overlays – Highway drainage –Types – Maintenance of different road surfaces – Maintenance of shoulders and roadway drainage – Pavement failures – Structural evaluation.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan, "Highway Engineering", Nemchand and Bros, 2011.*
2. *Kadiyali, L.R., N.B.Lal, "Principles and practices of Highway Engineering", Khanna Publication, 2005.*

Reference Books:

1. Sharma S.K, "Principles, Practice & Design of Highway Engineering" S.Chand & Co, 2011.

2. IRC: 37-2012, "Guidelines for the design of flexible pavements" (Third Revision).

3. K.P.Subramanian, "Transportation Engineering: Highway Railway Airport & Harbour Engineering", Scitech publications (India) Pvt. Ltd, 2003.

COURSE OUTCOME:

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

CO1: Understand the principles of various organisations for highway development.

CO2: Understand the geometric design standards for streets and highways.

CO3: Comprehend the various desirable properties of highway materials.

CO4: Design flexible and rigid pavements.

CO5: Know various measures to control pavement failures and maintenance methods.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M															L
CO2				H										M		
CO3										L			H			
CO4										H			M			
CO5									L						L	
16CPE019	M			H					L	H			H	M	L	

L-Low, M-Moderate (Medium), H-High

16CPE020 PRESTRESSED CONCRETE STRUCTURES Category: PE

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 16CPC502 Basic Structural Design – II (Concrete)

COURSE OBJECTIVES:

* To understand the basic concepts, principles and methods of prestressing.
* To compute shear strength and ultimate shear resistance capacity as per IS code.
* To determine losses in prestress and anchorage zone stresses.
* To be acquainted with the codal provisions for the design of prestressed concrete elements.
* To understand the design concepts of composite constructions.

UNIT - I : INTRODUCTION (09)

Principles – Pretensioning – Post – tensioning – Advantages and Types of prestressing – systems of prestressing –Comparison of prestressed concrete with reinforced concrete – Materials for prestressed concrete - Theory and behaviour of prestressed concrete beams in bending – calculation of fibre stresses for various section (Rectangle, I, T) of simply supported beam - Stress method – Moment of resistance method – Load balancing method.

UNIT – II : DESIGN OF PRESTRESSED CONCRETE BEAMS (09)

Pre tensioned and post tensioned simply supported rectangle, I, T sections – Stress method – Design for flexure, bond and shear – Introduction to End block – Transmission length – End zone reinforcement – Anchorage zone stresses-Guyon and Magnel's method – Analysis and design of end block.

UNIT - III : DESIGN OF TENSION AND COMPRESSION MEMBERS (09)

Design of prestressed tension members subjected to axial load – Design of prestressed compression members– Design of sleepers and poles.

UNIT - IV : LOSSES AND DEFLECTIONS (09)

Various losses in prestressed concrete members – losses due to elastic shortening of pre tensioned and post tensioned members – losses due to creep, shrinkage of concrete – Relaxation losses – friction and anchorage losses. Deflection of prestressed concrete flexural members – Effect of tendon Profile on deflection - Calculation of Elastic short term deflection for simply supported beams –Deflections due to creep – calculation of long term deflection.

UNIT – V : COMPOSITE PRESTRESSED CONCRETE BEAMS (09)

Types of composite construction – Transformation of composite sections – flexural analysis of composite simply supported beams – Differential Shrinkage - Limit state design criteria – partial prestressing – Non- prestressed reinforcements

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Krishnaraju.N, "Prestressed concrete", Tata McGraw Hill Publishing company Ltd.,New Delhi, 2008.*
2. *Sinha. N.C and Roy.S.K, "Fundamentals of prestressed concrete", S.Chand and Co. Ltd 2011.*
3. *Muthu K. U., Ibrahim Azmi, Janardhana Maganti, Vijayanand M, "Prestressed Concrete", PHI Learning Pvt. Ltd., 2016.*

Reference Books:

1. *IS: 1343- 2012, Prestressed Concrete — Code of Practice.*
2. *Lin .T.Y., and Ned H. Burns., "Design of prestressed concrete structures",John Wiley & Sons, International Edition, New York, 1995.*
3. *Dayaratnam.P., "Prestressed Concrete Structures" , Oxford and IBH Publishing Company pvt, Ltd, New Delhi, 2008.*
4. *N.Rajagopalan "Prestressed Concrete", Narosana Publications, 2006.*
5. *Guyon, Y. "Limit State Design of Prestressed Concrete Vols. I & II", Applied Science Publishers, London, 1974.*

COURSE OUTCOME:

CO1: Able to describe the systems and methods of prestressing and obtain the internal forces due to prestressing, being able to identify the primary and secondary components of the total internal forces.

CO2: Able to propose an appropriate system to prestress a particular structure and to design the prestressed concrete elements and end blocks as per the codal provisions.

CO3: Able to design tension and compression prestressed concrete members.

CO4: Able to evaluate the initial and time dependent losses and deflection of prestressed elements.

CO5: Able to determine the resultant stresses of prestressed concrete composite section.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	M							M	M		L	H	M	
CO2	H	M	M	L		L		M					L	H	M	
CO3	H	M	M	L		L		M					L	H	M	
CO4	H	M	M	L		L		M					L	H	M	
CO5	H	M	M	L		L		M					L	H	M	
16CPE020	H	M	M	L		L		M		M	M		L	H	M	

L-Low, M-Moderate (Medium), H-High

16CIE001 HIGHWAYS – STATE OF THE ART Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To give an overview about the design and construction of various types of highways and to understand the procedures adopted in the Department of Tamil Nadu Highways.

UNIT - I : HIGHWAYS - BIRD'S EYE VIEW (09)

Highway Planning in India:

Classification and Authorities of roads in India – Function and duties of Ministry of Road Transport and Highways (MORT&H) and Indian Roads Congress (IRC) - Highways Research centers in India – Financing of Highways Infrastructures.

Tamilnadu Highways Department organizational setup and duties - Project Announcements - Financial Allotment - Government Orders - Issue of Letter of Credit.

Geometric elements of Highways:

Terrain, Land width, Building lines and Control lines, Right of Way, Carriage Way, Camber, Kerbs, Shoulders, Side slopes, Footpaths, Sight distances, horizontal and vertical alignments [IRC Standards] – Typical cross section - Components of bridge structures.

UNIT – II : DESIGN AND CONSTRUCTION OF HIGHWAY PAVEMENTS (09)

Desirable properties and quality assurance tests of materials for flexible and rigid pavements - Design of bituminous paving mixes - Design factors for flexible and rigid pavements - Design of flexible pavement using IRC:37-2012 – Design of bituminous overlay using IRC:81-1997 - Design of rigid pavements using IRC:58-2011.

UNIT - III : DESIGN AND CONSTRUCTION OF BRIDGES (09)

Engineering Surveys for Alignment of road bridges - Investigations for bridge works and preparation of field particulars - linear waterway calculation.
Classification of bridges – Basics of bridge design and drawings – Construction practices in Bridges - RMC site machineries and operations – Construction site machineries and operations - Quality Assurance activities at plant and construction sites.

Grade Separators and Elevated Structures:

Basics - Common types of Interchanges - Trumpet interchange, Diamond interchange, Cloverleaf interchange, Rotary interchange and Directional interchange - General features and Geometric Standards – Construction problems.

UNIT - IV : HIGHWAY MAINTENANCE (09)

Road maintenance:

Basic objectives – Classification of maintenance activities – Procedure for inspection and planning maintenance works – Surface and subsurface drainage of roads – Road markings and appurtenances.

Pavement failures:

Defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments; Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural cracks, Spalling of joints and Mud pumping - Treatments.

Hill roads:

Construction & maintenance - V shaped drains, Shadow and swamp areas, land slide - causes, investigation, preventive and remedial measures - protection of embankment and cut slopes – flood damage and emergency works – problems and remedial measures in hill road construction.
Applications of geosynthetics, reinforced earth and soil nailing in highways.

UNIT – V : TENDERING AND ACCOUNTING PROCEDURES (09)

Tendering:

Estimate preparation and sanctions – tendering and contracting procedures, laws of contracts – COT approval – agreements

Accounting:

Recording measurements – bill preparation and processing – Working estimates – RAS – disputes and arbitration - Completion Certificates - Completion Report - Internal Audit and Accountant General Audit.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *T.F. Fwa, "The Handbook of Highway Engineering", CRC Press, 2006.*
2. *Nicholas J. Garber, Lester A. Hoel, "Traffic and Highways Engineering", Cengage Learning.*
3. *H.J.Yoder, "Principles of Pavement Design", John Wiley and Sons.*

Reference Books:

1. *Fred L. Mannering, Walter P. Kilareski, Scott S. Washburn, "Principles of Highway Engineering and Traffic analysis", Wiley student Edition.*
2. *Khanna K and Justo C E G, "Highway Engineering" Khanna Publishers, Roorkee, 2001.*
3. *Kadiyali L R, "Principles & Practice of Highway Engineering", Khanna Technical Publications, Delhi, 2000.*
4. *IRC codes (IRC:37–2012, IRC-SP:19-2001, IRC-SP:90-2010, IRC:81-1997, IRC-SP:48-1998, IRC:58-1998, etc.,).*
5. *Specifications for Road and Bridge works, MORT&H (Fifth Revision).*

COURSE OUTCOMES:

- **CO1:** This subject exposes the students about different types of highways and geometric elements of highways.
- **CO2:** The students will be able to design and construct both flexible and rigid pavements based on latest IRC guidelines.
- **CO3:** This chapter imparts knowledge on engineering surveys for road bridges and construction procedures in bridge design.
- **CO4:** The students will be provided with different aspects of pavements and hill roads.
- **CO5:** The students will be exposed to the tendering and accounting procedures of Tamil Nadu Highways department.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M												M			L
CO2	H	L		H								M		M	M	L
CO3	M								M					M	M	L
CO4												L				L
CO5								H								L
16CIE001	M	L		H				H	M			M	M	M	M	L

L-Low, M-Moderate (Medium), H-High

16CIE002 ENVIRONMENTAL LEGISLATIONS IN INDIA Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make the students conversant with the legislations in India.
- To understand the basic principles in pollution control.
- To expose the students to the pollution control policies in India.

UNIT - I : THE WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974 (09)

Definitions-Salient features-Powers & functions of Regulatory agencies–Responsibilities of occupier, provisions relating to prevention & control-procedures to obtain consent-Monitoring and compliance mechanisms-legal provision for violation of Water(P&CP)Act-Case studies on water polluting industries-Textile dyeing, Paper mills-Electroplating, Starch industries- inventorisation of new water polluting industry and its management-field visits.

UNIT – II : THE AIR (PREVENTION & CONTROL OF POLLUTION) ACT, 1981 (09)

Definition-Salient features- Powers & functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of occupier, provisions relating to prevention & control-procedures to obtain consent Monitoring and compliance mechanisms- legal provision for violation of Air(P&CP)Act- Case studies on Air polluting industries-Foundries, Cement, Thermal power plants- inventorisation of new Air polluting industry and its management-field visits.

UNIT – III : THE ENVIRONMENT (PROTECTION) ACT, 1986 (09)

Genesis of the Act-Salient features-Role of Central Government-various notifications and rules – prohibition on import of genetically modified organisms-chemicals-hazardous wastes- Batteries management-Restriction on Ozone depleting substances-EIA notification- Siting of industries-State level EIA Authorities-eco-mark-Control on noise pollution-coastal regulations- Monitoring and compliance mechanisms-Role of National Green Tribunals (NGT), Environmental courts & Public interest litigation -Case studies.

UNIT – IV : REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT (09)

Restriction on Hazardous waste - Bio-medical wastes - Recycled plastic wastes - Municipal solid wastes - e-waste - Salient features - Responsibilities of occupier / generator / local bodies / PCBs - Monitoring and compliance mechanisms - consent clearance, Authorisation, Registration procedures for industry specific - Issues & Challenges - Best practices - Case studies on lead refining, engineering units, hospitals, plastic units, Municipal landfills - field visits.

UNIT – V : ELECTRONIC WASTE (MANAGEMENT & HANDLING) RULES 2016 (09)

Definition-Environmental & Occupational Health hazards of e-waste-Salient features of E-waste Rules-Extended producers responsibility-issues and challenges –Compliance and Consent Clearance mechanisms-Best practices of E-waste management-Case studies on E-waste recycling units, Bulk consumers, Collection Centers -field visits.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Rosencrannz, S. Divan, M.L.Noble, "Environmental law and policy in India, cases, materials and statutes", Tripathi pvt.Ltd. Bombay.*
2. Stem A.C., "Air pollution, Vol. I to VIII", Academic press.
3. Shyam Divan and Armin Roseneranz, "Environmental law and policy in India", Oxford University Press, New Delhi, 2001.
4. Bat stone, Smith, Wilson, "The safe disposal of hazardous waste. Vol. I, II, & III", Joint study Sponsored by the world bank, the WHO, & UN Environmental Program UNEP, The world bank Freeman, H.M. standard Handbook of Hazardous Waste Treatment and Disposal, 1989.
5." E WASTE MANAGEMENT IN INDIA, Electronics for you, www. efymag.com.", 2009

Reference Books:

1. Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, "Integrated Solid Waste Management", McGraw- Hill, New York, 1993.
2.CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans, "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York, 2001.
4. Vesilind P.A., Worrell W and Reinhart," Solid waste Engineering", Thomson Learning Inc., Singapore, 2002.
5. Charles A. Wentz, "Hazardous Waste Management, Second Edition" McGraw Hill International Edition, New York,1995.
6. CPCB - Regulations

List of Websites:

1. www.usepa.gov/epaoswer/hazwaste/recycle/ecycling/index.htm
2. www.defra.gov.uk/environment/waste/index.htm
3. www.ec.gc.ca
4. www.environment.gov.au
5. http://ec.europa.eu/environment/waste/weee/index_en.htm
6. www.ewasteguide.info
7. www.basel.int
8. www.unep.org
9. http://www.unep.ch/ozone/index.shtml
10. www.cpcb.nic.in/Hazardous%20Waste/default_Hazardous_Waste.html
11. http://www.basel.int/industry/mppiwp/guid-info/index.html

COURSE OUTCOMES:

- **CO1:** Students able to conversant with the legislations related to the Water Act
- **CO2:** Students able to acquire knowledge about the legislations related to the Air Act
- **CO3:** Students able to get knowledge related to the Environment Act
- **CO4:** The Students will get idea about the regulations on Solid waste management.
- **CO5:** The student shall be able to enforce E waste rules.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	L				L	H		L	M	M	L	M	H	L	L
CO2	L	L				L	H		L	M	M	L	M	H	L	L
CO3	L	L				L	H		L	M	M	L	M	H	L	L
CO4	L	L				L	H		L	M	M	L	M	H	M	L
CO5	L	L				L	H		L	M	M	L	M	H	M	L
16CIE002	L	L				L	H		L	M	M	L	M	H	L	L

L-Low, M-Moderate (Medium), H-High

16AOEX01 **NANOSCIENCE AND TECHNOLOGY** **Category: OE**

(Common to All Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of nano systems
- To be familiar with various methods of synthesis of nano materials
- To analyze and understand the mechanical and electrical properties of nonmaterial and its applications
- To realize the importance of Nonporous materials and its applications
- To make the students to understand the fundamental aspects of properties leading to technology

UNIT I: NANO SYSTEMS (9)

Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Properties of Individual nanoparticles. Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Top down and Bottom up approach.

UNIT II : SYNTHESIS OF NANOMATERIALS (9)

Sol-Gel Process - Self assembly - Electrodeposition - Spray Pyrolysis - Flame Pyrolysis – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Chemical Vapor Deposition (CVD) – Metal Orgonic Chemical Vapor Deposition (MOCVD).Ball Milling - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE) – Melt Spinning process.

UNIT III : MECHANICAL AND ELECTRICAL PROPERTIES (9)

Nanoscale Mechanics - Introduction – Mechanical properties – Density Considered as an Example Property – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials –Plastic Deformation of Nanomaterials - The Physical Basis of Yield Strength – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity.

Introduction - Energy Storage Basics - General Information: Electrical Energy Storage Devices and Impact of Nanomaterials – Batteries – Capacitors - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls

UNIT IV: NANOPOROUS MATERIALS (9)

Nanoporous Materials – Silicon - Zeolites, mesoporous materials – nano membranes and carbon nanotubes - AgX photography, smart sunglasses and transparent conducting oxides- Hydrophobic & Hydrophilic materials – molecular sieves – nanosponges.

UNIT V: NANOTECHNOLOGY APPLICATIONS (9)

Applications of nanoparticles, quantum dots, Nanotubes and nanowires for nanodevice fabrication – Single electron transistors, coulomb blockade effects in ultra-small metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs – CNT based transistors – principle of Dip Pen Lithography.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Reference books:

1. *G. Timp. Editor, "**Nanotechnology**" AIP press, Springer-Verlag, New York, 1999*
2. *Hari Singh Nalwa, Editor, **"Nanostructured materials and Nanotechnology''**, Concise Edition, Academic Press, USA (2002).*
3. *Guozhong Gao, "**Nanostructures & Nanomaterials: Synthesis, Properties & Applications"**, Imperial College Press (2004).*
4. *K. T. Ramesh, "**Nanomaterials : Mechanics and Mechanisms"**, Springer 2009.*
5. *Kenneth J. Klabunde, "**Nanoscale materials in chemistry"**, John Wiley & Sons, 2001.*
6. *Hari Singh Nalwa, Editor, "**Hand book of Nanostructured Materials and Technology''**, Vol.1-5, Academic Press, USA (2000).*
7. *"**Hand book of Nanoscience, Engineering and Technology"** (The Electrical Engineering handbook series), Kluwer Publishers, 2002*
8. *N John Dinardo, Weinheim,"**Nanoscale characterization of surfaces & interfaces"**, Cambridge: Wiley-VCH, 2nd ed., 2000*
9. *G. Cao, "**Nanostructures & Nanomaterials: Synthesis, Properties &Applications"**, Imperial College Press, 2004.*
10. *J.George, "**Preparation of Thin Films"**, Marcel Dekker, Inc., New York. 2005.*

COURSE OUTCOME

CO1 : Analyze the particle size, particle shape, particle density, Size effect and properties of nanostructures. [Familiarity]

CO2 : Acquire knowledge in various methods of synthesis of Nano materials. [Application]

CO3 : Analyze the Elasticity of Nanomaterials , Electrical Energy Storage Devices and Aerogels. [Assessment]

CO4: Acquire knowledge in Zeolites, mesoporous materials, nano membranes and carbon nanotubes. [Familiarity]

CO5: Apply various nano materials to the LED, Transistor Applications. [Usage and Assessment]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		**H**		**M**		**L**							**L**	**L**		
CO2	**M**			**L**	**H**								**M**	**L**		
CO3		**H**			**L**		**M**						**M**	**L**		
CO4	**H**			**M**		**L**							**M**	**L**		
CO5	**L**		**H**				**M**					**M**	**L**	**L**		
16AOEX01	**L**	**L**	**L**	**L**	**L**	**L**	**L**					**L**	**L**	**L**		

L-Low, M-Moderate (Medium), H-High

16AOEX02 **MATERIAL CHARACTERIZATIONS** **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Thermo gravimetric analysis, Differential thermal analysis.
- To be familiar with various methods of microscope
- To analyze and understand the working principle of SEM, FESEM, EDAX, and HRTEM
- To realize the importance of Electrical methods and its limitations
- To understand the fundamental aspects and properties of spectroscopy techniques

UNIT I THERMAL ANALYSIS (9)

Introduction – thermo gravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves - differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermo mechanical parameters .

UNIT II MICROSCOPIC METHODS (9)

Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy - phase contrast microscopy - fluorescence microscopy - confocal microscopy - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.

UNIT III ELECTRON MICROSCOPY AND OPTICAL CHARACTERISATION (9)

SEM- FESEM- EDAX - HRTEM: working principle and Instrumentation – sample preparation – Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.

UNIT IV ELECTRICAL METHODS (9)

Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V, I-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations.

UNIT V SPECTROSCOPY (9)

Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, ESCA and SIMS- proton induced X-ray Emission spectroscopy (PIXE) – application – mass spectroscopy.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Reference books:

1. *Stradling, R.A; Klipstain, P.C;* ***"Growth and Characterization of semiconductors"****, Adam Hilger, Bristol,1990.*
2. *Belk, J.A;* ***"Electron microscopy and microanalysis of crystalline materials"****, Applied Science Publishers, London, 1979.*
3. *Lawrence E.Murr,* ***"Electron and Ion microscopy and Microanalysis principles and Applications"****, Marcel Dekker Inc., New York, 1991*
4. *D.Kealey & P.J.Haines,* ***"Analytical Chemistry"****, Viva Books Private Limited, New Delhi, 2002.*
5. *G. Gao,* ***"Nanostructures and Nanomaterials"****, Imperial College Press, London, 2006*
6. *Y. Gogotsi,* ***"Nanomaterials Handbook"****, CRC Taylor and Francis, New York, 2006*
7. *Banwell,* ***"Fundamentals of Molecular Spectroscopy"****, Tata McGraw-Hill, 1994.*

COURSE OUTCOME

CO1: Analyze the properties of TGA,DTA and DSC. [Assessment]
CO2: Acquire knowledge in various types of microscopes. [Familiarity]
CO3: Analyze the working principle and Instrumentation of SEM, FESEM, EDAX, and HRTEM [Familiarity]
CO4: Acquire knowledge in I-V and C-V characteristics. [Application]
CO5: Analyze the Principles and instrumentation of Spectroscopy methods. [Familiarity]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		H			M	M	L							L	L	
CO2	H	M	M				L					L		M	L	
CO3		H	M	M	L									M	L	
CO4	M	H		L	M									L	L	
CO5		M	H		L	M						L		L	L	
16AOEX02	L	H	L	L	L	L	L					L		M	L	

L-Low, M-Moderate (Medium), H-High

16AOEX03 **ELECTROCHEMICAL TECHNOLOGY** **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- This course aims at making Mechanical Engineers know about Electrochemical principles applied in manufacturing of Chemical products, fabrication of metals, metallurgy and corrosion studies

UNIT – I **(09)**

Fundamental concepts, electron transfer, mass transfer, adsorption, electro-catalysis, phase formation in electrode reaction, assessment of cell voltage, costing of electrolytic process, performance and figure of merit. Typical cell designs. Laboratory data and scale-up.

UNIT – II **(09)**

Chlor-alkali industry-concept of brine electrolysis, chlorine cell technology, the production of NaOH. Water electrolysis, sodium chlorate, hydrogen peroxide, ozone, cuprous oxide and synthesis of metal salt via anodic dissolution, Organic electro synthesis-dimerization of acrylonitrile, indirect electrosynthesis

UNIT – III **(09)**

The extraction, refining and production of metal–electro-winning, cementation, electro-refining, Electro-deposition of metal powders. Corrosion and its control-thermodynamics and kinetics of corrosion reactions, corrosion problems in practice, corrosion prevention and control, corrosion problems in electrolytic processing, corrosion measurement and monitoring

UNIT – IV **(09)**

Metal finishing-electroplating, electroless plating, conversion coatings, electroforming, electrochemical etching. Batteries and fuel cells-battery characteristics, battery specifications, evaluation of battery performance, battery components. Fuel cells.

UNIT – V **(09)**

Water purification, effluent treatment and recycling of industrial process stream- metal ion removal and recovery, treatment of liquors containing dissolved chromium, electrolytic method of phase separation, flue gas desulphurization, electrodialysis. Electrochemical sensor and monitoring techniques, polarographic to anodic stripping voltammetry, ion selective electrode, electrochemical biosensors.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books

*1. Derek Pletcher and Frank C Walsh, **"Industrial Electrochemistry"**, 2nd edition, Chapman & Hall, UK, 1990*

*2. A.T.Kuhn, **"Industrial Electrochemistry"**, Elsevier Publishers, 1972*

Reference books

*1. C.L. Mantell, **"Chemical Engineering Series – Industrial Electrochemistry"**, McGraw Hill Co., Inc. London, 1958*

*2.Ullmann's **"Encyclopedia of Industrial Chemistry"**, John Wiley & Sons, Vol.6, pp: 399 - 481, 2003.*

*3.Krik–"**Othmer Encyclopedia of Chemical Technology"**, 4th edition, Vol: I., Pp938 –1025 (1991)*

*4.N.M.Proutand J.S.Moorhouse**, "Modern Chlo-Alkali Technology"**, Vol. IV, Elsevier Applied Science, London, 1990*

COURSE OUTCOMES

Students after the completion of this course:

CO 1: Students will be able to understand the electrodic processes and design cell requirements

CO 2: Students can apply the electrolysis principle in manufacture of materials required for regular use.

CO 3: Students will be able to apply their technical skill in metallurgy.

CO 4: Students will be able to acquire knowledge in all metal finishing techniques.

CO 5: Students will gain knowledge in solving the problems of corrosion of equipment and battery systems.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	H	M	M	H	L							L	M		
CO2	L	M	H	L	H	L							H	L	L	
CO3	H	L	H	M	M	H							L	M		
CO4	M	L	L	L	M	H							L	L	L	
CO5	L	M	H	L	H	M							L	M		
16AOEX03	M	M	M	L	H	M							L	M	L	

L-Low, M-Moderate (Medium), H-High

16AOEX04 **POLYMER TECHNOLOGY** **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* This course is aimed to make Mechanical Engineers apply their skills in identifying the types of polymers and their properties applicable to plastics and rubber processing

UNIT – I CHEMISTRY OF HIGH POLYMERS (09)

Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; metallocene polymers and other newer techniques of polymerization, copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension and emulsion.

UNIT – II SYNTHESIS AND PROPERTIES (09)

Commodity and general purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, ABS, Fluoropolymers - Thermosetting polymers: PF, MF, UF, Epoxy, Unsaturated polyester. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex, SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE.

UNIT – III POLYMER TECHNOLOGY (09)

Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, cross-linking and vulcanization. Compression molding, transfer molding, injection molding, blow molding, reaction, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.

UNIT – IV POLYMER BLENDS AND COMPOSITES (09)

Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, FRP, particulate, long and short fibre reinforced composites.

UNIT – V POLYMER TESTING (09)

Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Reference Books

*1. F.W. Billmeyer, Jr., **"Textbook of polymer science"**, Wiley - Interscience, N.Y.(1971)*

*2. G.Odian , **"Principles of polymerization"**,Wiley – Interscience (1981)*

*3. Gowarikar V.R. and others , **"Polymer science"**, Wiley Eastern (1986).*

*4. Fenner R.T., **"Principles of polymer processing"**, Chemical publishing N.Y. (1979)*

COURSE OUTCOMES

Students after the completion of this course:

CO1: Will be able to identify different types of polymers by structure and behaviour, properties and their method of polymerisation.

CO2: Will be able to apply various processes of fabrication of plastics and rubber.

CO3: Will be able to distinguish polymer blends and composites and understand their specific applications.

CO4: Will be able to test the polymer specimens for mechanical properties applicable for various end uses.

CO5: Will be able to test the polymer specimens for electrical properties applicable for various end uses.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	L	L	M	H								L		
CO2	L	L	H	M	H	L									M	
CO3	M	M	L	L	M	L								L		
CO4	L	L	M	M	M	H										
CO5		H	L	L	H	M								L	M	
16AOEX04	L	M	M	L	M	M								L	M	

L-Low, M-Moderate (Medium), H-High

16COEX05 DISASTER MANAGEMENT AND MITIGATION Category: OE

(Common to all the branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To give knowledge about basics of Disaster Management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about Response and Recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT - I : INTRODUCTION (08)

Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, the Hyogo framework for action, Post 2015 framework, Disaster trends.

UNIT – II : HAZARDS AND RISK VULNERABILITY (10)

Hazard Identification and Hazard Profiling, hazard analysis, Types of hazards- Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – purpose, Risk Acceptibility, Alternatives, Personnel. Political/social, Economic. Vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile. Factors Influncing Vulnerability, risk Perception.

UNIT - III : MITIGATION AND PREPAREDNESS (08)

Mitigation - types of mitigation ,Obstacles in mitigation, Assement and selection of Mitigation options, Emergency response capacity as , Incorporating Mitigation into development and relief projects.

Prepareness- Government Preparedness, Public Preparedness, Media as a public educator. Obstacles to public education and preparedness.

UNIT – IV : RESPONSE AND RECOVERY (09)

Response the Emergency- Pre disaster, post disaster, Provision of water, food and shelter, volunteer management , command , control and coordination.

Recovery- short term and long term recovery components of recovery- planning, coordination, information, money and supplies, allocation of relief funds, personnel. Types of recovery- Government, Infrastructure, Debris removal disposal and processing, environment, housing, economic and livelihood, individual, family and social recovery- special considerations in recovery.

UNIT – V : PARTICIPANTS (10)

Governmental Disaster management agencies- Fire, law, emergency management, Emergency medical service, Military and other resources. Structures- local, regional, national. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance.

Non Governmental Organisations – operations, NGO/ Military coordination, standard of conduct. The role of Private sector and academia.

Multilateral organisations - UN agencies and progammes, Regional & International organisations. International Financial Institutions- the world bank, IMF, ADB, IADB. Special considerations.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Damon P. Coppola, "Introduction to International Disaster management", Elsevier publication, 2015*

Reference Books:

1. Brassard, Caroline, Giles, David W., Howitt, Arnold M., "Natural Disaster Management in the Asia-Pacific", Policy and Governance.
2. "Disaster Management", Global Challenges and Local Solutions, Universities Press, 2009.
3. Jack Pinkowski, "Disaster Management Handbook", CRC Press , January 22, 2008.
4. Disaster Management Guidelines, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

COURSE OUTCOME:

CO1: Able to get knowledge about basics of Disaster management.

CO2: Able to impact knowledge about Hazards and vulnerability

CO3: Able to know about Mitigation and preparedness.

CO4: Able to attain knowledge about response and recovery.

CO5: Able to learn about the participants involved in the disaster management activity.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1		L			L	L		L								L
CO2	L	H		M	L	M						L	L			L
CO3	L	L			H	M						L	L			L
CO4	L	M		L	L	M	M									L
CO5		M		L	L	M										L
16COEX05	L	M		L	L	M	M					L	L			L

L-Low, M-Moderate (Medium), H-High

16COEX06 **ENVIRONMENTAL MANAGEMENT** **Category: OE**

(Common to all the branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.16CHS2Z4 – Environmental Science and Engineering

COURSE OBJECTIVES:

- To understand the importance of nature and study about the water, air and soil pollution control as well as solid waste management.

UNIT – I : NATURE AND SCOPE OF ENVIRONMENTAL PROBLEMS (09)

Environment and sustainable development – Natural and human environmental disturbances – Global warming –acid rain – ozone depletion – effects and control - climate change conventions – Kyoto protocol – India's efforts for Environmental protection – Public policy and role of NGO's.

UNIT – II : WATER POLLUTION AND CONTROL (09)

Fresh water and its pollution – Natural processes – sources and pollutants – pollution due to industrial, agricultural and municipal wastes – effects on streams - limitations of disposal by dilution – BOD consideration in streams – Oxygen Sag Curve – Strategies for sustainable water management – Marine environment and its management – Water acts.

UNIT - III : AIR AND NOISE POLLUTION (09)

Pollutant emissions - sources and sink – effects of air pollution on human health, vegetation and climate– Global effects – prevention and control of air pollution – Control of particulates – Air pollution surveys and sampling – Air quality monitoring - Air Act – Management of air pollution – Sound level – Effect of noise on people – Environmental noise control- noise pollution rules, 2000.

UNIT – IV : SOLID WASTE MANAGEMENT AND SOIL POLLUTION (09)

Sources – Characteristics – Quantities – Collection methods – Processing and disposal techniques – Onsite Handling, storage and processing – sanitary landfill – Incineration and pyrolysis – Composting – aerobic and anaerobic of compositing – Recycling and reuse of solid wastes – Hazardous wastes – Definition – Sources & types only – Integrated system for waste management – The Basel convention Land use and degradation – Management problems – strategies for sustainable land management – soil pollution –wetland conservation.

UNIT – V : ENVIRONMENTAL MANAGEMENT SYSTEM (09)

Terminology – installation and common motives of EMS – Environmental standards – ISO 14000 (Series) – basic principles – Environmental Audit – Environmental Impact assessment - Trade rules and environmental protection– Practices for Waste Minimisation and Cleaner Production.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *N.K.Uberoi, "Environmental Management", Excel Books, New Delhi (2006).*
2. Rao, "*Air Pollution", Tata McGraw-Hill Education, 01-Jun-1988*

Reference Books:

1. S.Vigneahwaran,M.Sundaravadivel and D.S.Chaudhary ,EnvironmentalManagement, SCITECH Publications(India) Pvt.Ltd, Chennai & Hyderabad (2004).
2. Technobanoglous, Environmental management, McGraw Hill Book Company (2006).

COURSE OUTCOME:

CO1: Students exposed to know common issues related with environment.

CO2: Students able to know the sources, causes and effects of water pollution.

CO3: Able to attain knowledge related with air and noise pollution.

CO4: Able to understand the various management techniques of solid waste and soil Pollution.

CO5: Able to acquire knowledge on Environmental Management Systems.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L					M						L	H		L
CO2	L	M			L		H					L	H	H	L	L
CO3	L	M			L		H					L	H	H	L	L
CO4	L	M			L		H					L	H	H	L	L
CO5	M	L					M						L	H	L	L
16COEX06	L	M			L		H					L	H	H	L	L

L-Low, M-Moderate (Medium), H-High

16COEX07 TOWN PLANNING AND ARCHITECTURE Category: OE

(Common to all the branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* Students are introduced the basics of Town Planning and Architecture.

UNIT - I : TOWN PLANNING (09)

History of evolution of towns - Town and environment – Planning acts – land use classification – Transportation network - Climate, humidity, wind and radiation - Surveys and Data collection - Residential neighborhoods - Industrial areas - Public Buildings - Housing and Slum clearance.

UNIT – II : BUILDING RULES AND GUIDELINES (09)

General – Zoning regulations – Regulations regarding layouts or subdivisions – Building regulations – Rules for special types of buildings – Floor space index – minimum plot size and building front age – Open spaces – Minimum standard dimensions of building elements – Provision for lighting and ventilation – Provision for means of access – Provision for urban growth.

UNIT - III : BASIC ELEMENTS OF ARCHITECTURE (09)

Introduction of Architecture – Definition – Mass and space visual emotional effects of geometric forms and their derivatives– The sphere, the cube, the pyramid, the cylinder and cone – The aesthetic qualities of Architecture – Proportion, scale, balance, symmetry, rhythm and axis – contrast in form – Harmony – Consideration of comfort factors acoustics, lighting, ventilation and thermal aspects.

UNIT - IV : PRINCIPLES OF OREINTATION AND PLANNING OF BUILDINGS (09)

General – Factors affecting orientation – Sun – Wind – Rain – Orientation criteria for Indian conditions – Principles governing the theory of Planning – General requirements of site and building – Functional planning of buildings.

UNIT – V : ELEMENTS OF INTERIOR DESIGN (09)

General – Decorative Materials – Cement Bonded Board (BISON PANEL), Water proof cement paint, Industrial glazing and Roofing, unit masonry, plaster and dry wall, Wall surface materials, Effect of colour on architecture – Home furnishing – plans in rooms.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *S.C.Rangwala, "Elements of Town Planning", McGraw Hill, London, 2006.*
2. *Biswas Hiranmay*, "*Principles of Town Planning and Architecture", VAYU Education of India, 2012.*

Reference Books:

1. V.S.Pramar, 'Design fundamentals and architecture' Lakshmi Publishers, 2003.
2. Hiraskar, "Fundamentals in town planning" Khanna Publishers, 2005.

COURSE OUTCOME :

CO1: Students will be able to know about the basics of town planning and building rules.

CO2: Students will be able to gain knowledge on building rules & regulations.

CO3: Students able to apply the architectural principles in the area of Civil Engineering.

CO4: Students will be able to do planning of various buildings.

CO5: Students will be able to understand about interior design of buildings.

COURSE ARTICULATION MATRIX :

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1				M								L		L		
CO2							M				L	L				
CO3		L		L						M			L			
CO4		L		L						M						
CO5		M						L				H				
16COEX07		L		L			M	L		M	L	L	L	L		

L-Low, M-Moderate (Medium), H-High

16MOEX08 TOTAL QUALITY MANAGEMENT FOR ENGINEERS Category: OE

(Common to All Branches except PROD)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES

- To impart knowledge to develop a product with the required quality at a reasonable price and to satisfy the requirements under various quality standards

UNIT - I QUALITY CONCEPTS (9)

Definition of quality, dimensions of quality, quality planning, quality costs concepts - basic concepts of total quality management, principles of TQM, leadership concepts - quality council, quality statements, strategic planning- steps in strategic planning- Deming philosophy, barriers in TQM implementation, benefits of TQM.

UNIT - II TQM PRINCIPLES (9)

Contribution of TQM Gurus - customer perception of quality - retention, employee involvement - motivation, empowerment, performance appraisal, continuous process improvement – Juran trilogy, PDSA cycle, 5S concept, kaizen, supplier partnership - supplier rating – performance measures- Malcom Balridge National Quality Award.

UNIT - III STATISTICAL PROCESS CONTROL (9)

Seven old and new tools of quality - statistical fundamentals - population and sample – normal curve - control charts for variables ,attributes and its applications- process capability - concept of six sigma.

UNIT - IV TOOLS AND TECHNIQUES (9)

Benchmarking needs and benefits - benchmarking process - quality function deployment (QFD) - house of quality - Taguchi quality loss function - total productive maintenance (TPM) - pillars of TPM - Failure Mode Effective Analysis (FMEA) - Failure rate- types of FMEA - stages of FMEA- case studies.

UNIT - V QUALITY SYSTEMS (9)

Introduction to ISO 9000 and other quality system - ISO 9001:2015 quality system – elements - implementation of quality system - documentation - quality auditing - QS 9000, ISO 14000 - concept, requirements and benefits- integrating ISO 14000 with ISO 9000 – OSHSAS 18001,Implementation of TQM in manufacturing industry.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1. Dale H.Besterfield, et al., **"Total Quality Management",** Pearson Education, 2008.*

*2. Subburaj Ramasamy, **"Total Quality Management",** Tata McGraw Hill, 2008.*

3.Vilas S.Bagad, "Total Quality Management", TECHNICAL PUBLICATIONS, 2017.

Reference Books

1. *James R.Evans & William M.Lidsay,* ***"The Management and Control of Quality",****Thomson Learning, 2002.*
2. *Feigenbaum.A.V.* ***"Total Quality Management",*** *McGraw-Hill, 1991.*
3. *Zeiri,****"Total Quality Management for Engineers"*** *Wood Head Publishers, 1991*
4. *P.N.Mukherjee****"Total Quality Management"****,PHI Publishers,2006*
5. *John.L Hradesky* ***"Total Quality Management Hand book"*** *McGraw-Hill, 1995.*

COURSE OUTCOMES

On completion of this course, students will be able to

- **CO1***:* Apply the principle of strategic planning, Deming philosophy and leadership concepts in industries.
- **CO2:** Apply the principle of TQM in industries.
- **CO3:** Apply the principle of statistical process control in industries.
- **CO4**: Select appropriate quality tools to meet industrial requirements.
- **CO5:** Implement appropriate quality standards for industries.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	H			M			L	L		L	L	M	L	M
CO2	L	H			M			L	L		L	L	M	L	M
CO3	L	H			M			L	L		L	L	M	L	M
CO4	L	H			M			L	L		L	L	M	L	M
CO5	L	H			M		L	L	L		L	L	M	L	M
16MOEX08	L	H			M		L	L	L		L	L	M	L	M

L-Low, M-Moderate (Medium), H-High

16MOEX09 **COMPOSITE MATERIALS** **Category: OE**

(Common to all Branches)

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1.16CBS2Z3 - Material Science

COURSE OBJECTIVES:

* To impart the fundamentals of composite materials with different reinforcement, matrix materials and comprehend the types of manufacturing methods for advance composite materials to meet various engineering requirements.

UNIT – I INTRODUCTION TO COMPOSITE MATERIALS (9)

Types and characteristics of composite materials - Mechanical behavior - Basic terminology and Manufacture of laminated fiber - Reinforced composite materials - Current and potential advantages - Applications of composite materials.

UNIT - II REINFORCEMENT AND MATRICES (9)

Different types of fibers - Properties and applications of fibers - Roll of matrix - Matrix materials, Selection of matrix -Thermoset matrix -Thermoplastic matrix, Fiber architecture – Natural Fibers.

UNIT – III DESIGN OF COMPOSITE STRUCTURES (9)

Elements of Design - Steps in design process - Elements of analysis in design - Analysis iterations - Design analysis stages - Material selection - Configuration selection - Laminate joints - Design requirements and design failure criteria.

UNIT – IV MANUFACTURING OF ADVANCED COMPOSITES (9)

Bag-Molding process-Compression molding- Pultrusion-Filament winding-Liquid composite molding processes-Resin film infusion-Elastic reservoir molding-Tube rolling-Forming methods for thermoplastic matrix composites.

UNIT - V METAL, CERAMIC AND CARBON MATRIX COMPOSITES (9)

Metal matrix composites - Manufacturing processes - Ceramic matrix composites- Mechanical properties - Manufacturing processes - Carbon matrix composites - Fabrication methods - Applications.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1. Krishnan K., Chawla **"Composite Materials Science and Engineering"**, Springer (India) Private Limited, 2011.*

*2.P.K. Mallick , **"Fiber Reinforced Composite materials, Manufacturing and Design"**, CRC Press, Taylor and Francis Group, Boca Raton, London, Newyork 2010*

Reference Books

*1. A.K.Bhargava, **"Engineering Materials: Polymers, ceramics and composites"**, Pentice Hall of India Limited, 2010.*

*2. Hyer M., Stress Analysis of Fiber – **"Reinforced Composite Materials"**, Tata McGraw Hill, 1998.*

*3. Madhujit Mukhopadhyay , **"Mechanics of Composite Materials and Structures "**, Universities Press (India) Private Limited, 2009.*

*4. Robert M.Jones, **"Mechanics of Composite Materials"**, Taylor & Francis Group, 2010.*

5. Web Portal: Composite Materials {Nptel .Mechanical Engineering}

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the mechanics and behaviour of reinforced composite materials for specific applications and developing composite materials for sustainability

CO2: Formulate different types of reinforcement and matrices to develop new composite material for the various application

CO3: Design and manufacture post processing methods of composite structures and capable to perform various analysis

CO4: Execute different methods of manufacturing advanced composites to meet the innovate demand in engineering.

CO5: Fabricate metal matrix, ceramic matrix and carbon matrix composite for various engineering application to meet the societal demand.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	H			M	M				L		H		L
CO2	H	M	M	M	M		L				M		M	M	
CO3	M	M	M	M		L	M				L		L	M	
CO4	M	M	M	L		H	L		L		M		M	L	
CO5	L	L		L		M	L					L	M	M	
16MOEX09	M	M	M	L	L	M	L		L		L	L	M	L	L

L-Low, M-Moderate (Medium), H-High

16MOEX10 **AUTOMOBILE ENGINEERING** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The learners are able to visualize the scope of Automobile Engineering.

UNIT – I INTRODUCTON TO AUTOMOTIVES (9)

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design

UNIT - II POWER SOURCE FEATURES (9)

Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems - Pollutant emissions and their control; Catalytic converter systems, Electronic Engine management systems

UNIT - III TRANSMISSION, SUSPENSION AND BRAKING SYSTEMS (9)

Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and Preliminaries of suspension systems

UNIT - IV AUXILIARY SYSTEMS (9)

Electrical and electronic systems, safety systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.

UNIT - V TESTS, SERVICE AND MAINTENANCE (9)

Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions Check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books

*1. Dr. Kirpal Singh, **"Automobile Engineering Vol. I & II"**, Standard Distributors Publishers, 2012.*

*2. R.B.Gupta, **"Automobile Engineering"** Sathya Prakashan, New Delhi, 2006.*

Reference Books

*1. William H.Crouse, **"Automotive Mechanics"**, McGraw Hill Book Co. 2004.*

*2. K.K. Ramalingam, **"Automobile Engineering – theory and Practice"** SciTech Publications, 2001.*

*3. Joseph Heinter **"Automobile Mechanics Principles and Practice"** Affiliated East West Press, 1997.*

*4. Jain K.K. and Asthana. R.B, **"Automobile Engineering"** Tata McGraw Hill Publishers, New Delhi, 2002.*

*5. Heinz Heisler, **"Advanced Engine Technology"** SAE International Publications USA, 1998.*

COURSE OUTCOMES:

On completion of this course, learners will be able to:

CO1: Identify the different components in an automobile.

CO2: Clearly understand different auxiliary and transmission systems.

CO3: Explain the working of various parts like engine, transmission, clutch, brakes

CO4: Understand the environmental implications of automobile emissions

CO5: Develop a strong base for understanding future developments in the automobile industry

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	L	H	M	M	M	L	L	L	H	M	M	H
CO2	H	M	H	H	M	H	L	L	L	M	M	L	H	M	H
CO3	M	M	M	L	M	H	M	L	L	M	H	L	H	H	M
CO4	H	M	H	M	H	M	H	H	M	M	H	L	L	L	H
CO5	M	L	L	L	M	H	M		L	H	H	H	H	M	H
16MOEX10	M	M	M	M	H	H	M	L	L	M	M	M	M	M	H

L-Low, M-Moderate (Medium), H-High

16EOEX11 RENEWABLE ENERGY SOURCES AND TECHNOLOGY **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

* To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT - I SOLAR ENERGY (9)

Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.

UNIT - II WIND ENERGY (9)

Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application

UNIT - III BIOMASS ENERGY (9)

Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.

UNIT - IV OCEAN AND GEOTHERMAL ENERGY (9)

Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC.

Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Overview of micro and mini hydel power generation

UNIT - V RENEWABLE ENERGY POLICIES (9)

Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy - Efficiency.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. Rao. S. and Dr. Pamlekar B.B, ***"Energy Technology",*** *Khanna Publishers, Second Ed. 1997*

2. Pai and Ramaprasad, ***"Power Generation through Renewal sources",*** *Tata McGraw Hill – 1991*

Reference Books:

*1. Rai , G.D., "**NonConventional sources of Energy**", Khanna Publishers , IV Ed.,2009*

*2. Bansal NK, Kleeman and Meliss, M , "**Renewable Energy Sources and Conversion Techniques**", Tata McGraw Hill, 1996*

*3. Roland Wengenmayr, Thomas Buhrke, **"Renewable energy: Sustainable energy concepts for the future"**, Wiley-VCH, 1st edition, 2008.*

COURSE OUTCOME:

CO1: Realize the need for utilizing the energy from clean and Sustainable energy resources.

CO2: Describe the principles of operation of the broad spectrum of renewable energy Technologies

CO3: Analyze energy technologies from a systems perspective.

CO4: Articulate the technical challenges for each of the renewable sources

CO5: Create solutions for alternate energy issues

CO6: Discuss economic, technical and sustainability issues involved in the integration of renewable energy systems

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	M	M	M	M			L	L	L	H	M	M
CO2	H	H	M	M	M	M	M	L		L	L	L	H	H	H
CO3	H	M	M	M	M	M	M	M			L	L	M	H	H
CO4	M	H	M	L	M	H	M	M		L	L	L	H	H	H
CO5	M	H	H	H	M	M	M	M		L	L	L	M	H	M
CO6	H	M	M	M	M	M	M		H	H	L	L	M	H	M
16EOEX11	H	H	M	M	M	M	M	L	L	L	L	L	H	H	H

L-Low, M-Moderate (Medium), H-High

16EOEX12 **SMART GRID TECHNOLOGY** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

* To gain knowledge on the fundamentals of smart grid technologies, its architecture and its managements. Also the students should learn many of the challenges facing the smart grid as part of its evolution.

UNIT - I SMARTGRIDS: MOTIVATION, STAKES AND PERSPECTIVES (9)

Introduction – Information and Communication technologies serving the electrical system – Integration of advanced technologies – Definitions of Smart Grids – Objectives addressed by the Smart Grid concept – Socio-economic and environmental objectives – Stakeholders involved the implementation of the Smart Grid concept – Research and scientific aspects of the Smart Grid – Smart Grids from the customer's point of view.

UNIT - II INFORMATION AND COMMUNICATION TECHNOLOGY (9)

Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology for smart grids, standards for information Exchange, Information security for the smart grid - Cyber Security Standards - IEEE1686 - IEC62351.

UNIT - III SENSING AND MEASUREMENT (9)

Synchro Phasor Technology – Phasor Measurement Unit, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI.

UNIT - IV CONTROL AND AUTOMATION (9)

Distribution automation equipment – Substation automation equipments: current transformer, potential transformer, Intelligent Electronic Devices, Bay controller, Remote Terminal Unit. Distribution management systems – SCADA: modeling and analysis tools, applications

UNIT- V REGULATION OF SMARTGRIDS AND ENERGY STORAGE SYSTEMS (9)

Regulation and Economic models – Evolution of the value chain – The emergence of a business model for smart grids – Regulation can assist in the emergence of SmartGrids – The standardization of SmartGrids - Energy Storage Technologies-Methods - Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheel, Super-Conducting magnetic energy storage system, Super Capacitor.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid Technologies and applications", John Wiley Publishers Ltd., 2012

2. Nouredine Hadjsaid, JeanClaude Sabonnadiere, "Smart Grids", Wiley Publishers Ltd., 2012

*3. Lars T. Berger, Krzysztof Iniewski, **"Smart Grid applications, Communications and Security",** John Wiley Publishers Ltd., 2012*

Reference Books :

1. *Yang Xiao,* ***"Communication and Networking in Smart Grids",*** *CRC Press Taylor and Francis Group, 2012.*
2. *Caitlin G. Elsworth,* ***"The Smart Grid and Electric Power Transmission"****, Nova Science Publishers Inc, Aug 2010 .*

COURSE OUTCOME:

CO1: Develop and demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures, Applications

CO2: Design a smart grid and to meet the needs of a utility, including Meeting a utility's objectives, helping to adopt new technologies into the grid

CO3: Creating a framework for knowledgeable power engineers to operate the grid more effectively

CO4: Transfer the available information from any part of the power system to centralized control centre.

CO5: Handle the smart meter, sensors and intelligent devices to measure the electrical quantity.

CO6: Control the Electrical quantity from remote place

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1				L	L	M	H	L	M	M	M	H	M	H	M
CO2	L	L	M	M	M	M	M	L	M	M	M	M	M	M	H
CO3				M	M	M	M	M	M	M	M	H	M	M	M
CO4	L			M	M	M	H		M	M	M	H	M	H	H
CO5	M		L	M	M	M	M		M	M	M	M	M	M	M
CO6	L	L	M	L	M	M	L		M	M	M	M	M	M	M
16EOEX12	L	L	L	M	M	M	M	L	M	M	M	H	M	M	M

L-Low, M-Moderate (Medium), H-High

16LOEX13 **PRINCIPLES OF COMMUNICATION** **Category:OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the concepts of analog communication
- To gain the fundamental knowledge of digital communication
- To be familiar with the fundamentals of satellite and optical communication

UNIT- I AMPLITUDE MODULATION (9)

Introduction to communication systems- Electromagnetic spectrum – Principle of amplitude modulation − AM envelope − frequency spectrum and bandwidth – modulation index and percentage of modulation − AM power distribution –AM generation and-detection – square law modulator- envelope detector.

UNIT – II ANGLE MODULATION (9)

Frequency modulation and phase modulation- FM and PM waveforms – phase deviation and modulation index − frequency deviation and percentage of modulation − Frequency analysis of angle modulated waves- Bandwidth requirements for Angle modulated waves – generation and detection of FM – Armstrong modulator- Foster Seely Discriminator.

UNIT - III PULSE MODULATION (9)

Sampling and Quantization – Pulse Amplitude modulation- Pulse width modulation –Pulse position modulation- Pulse code modulation- PCM transmitter and receiver - Signal to Quantization noise ratio – Differential Pulse Code Modulation − Delta modulation − Adaptive Delta modulation

UNIT - IV DIGITAL COMMUNICATION (9)

Introduction – ASK, FSK, PSK- transmitter and receiver – QPSK transmitter and receiver – M ary PSK – Error probability in PSK, FSK.

UNIT -V SATELLITE AND OPTICAL COMMUNICATION (9)

Satellite Communication Systems-Transmitter and receiver- Kepler's Law – LEO and GEO Orbits – GEO Stationary orbit-–Optical Communication Systems – Transmitter and receiver- Sources and Detectors- Types of Optical Fiber – Losses

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Wayne Tomasi, "Advanced Electronic Communication Systems", 6/e, Pearson Education, 2007.*
2. *Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons., 2008.*

Reference Books:

1. *H.Taub,D L Schilling ,G Saha , "Principles of Communication"3/e,2007.*
2. *B.P.Lathi "Modern Analog and Digital Communication systems", 3/e, Oxford University Press, 2007*
3. *Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.*
4. *B.Sklar "Digital Communication Fundamentals and Applications" 2/e Pearson Education 2007.*

COURSE OUTCOMES:

Upon completion of this course, the students will have the:

CO1. Basic knowledge of amplitude modulation systems

CO2. Basic knowledge of angle modulation systems

CO3. Fundamental knowledge of digital communication systems

CO4. Understanding of digital transmission techniques

CO5. Fundamental knowledge of satellite communication system

CO6. Fundamental knowledge of optical communication system

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M									L	M	L	
CO2	M	M	M									L	M	L	
CO3	M	M	M									L	L	L	
CO4	M	M	M									L	M	L	
CO5	M	M	M									L	L	L	
CO6	M	M	M									L	M	M	
16LOEX13	M	M	M									L	M	L	

L-Low, M-Moderate (Medium), H-High

16LOEX14 MICROCONTROLLERS AND ITS APPLICATIONS **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To gain knowledge on basics of microcontrollers
- To get exposure to programming of microcontroller 8051
- To acquire knowledge on interfacing of peripherals with 8051 and PIC microcontrollers
- To get exposure on applications of microcontrollers

UNIT - I INTRODUCTION TO MICROCONTROLLER (9)

Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming – Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE – Introduction to Embedded systems - Architecture 8051 family - PIC 18FXXX – family – Memory organization

UNIT - II PROGRAMMING OF 8051 MICROCONTROLLER (9)

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication of 8051.

UNIT - III PROGRAMMING OF PIC18FXXX MICROCONTROLLER (9)

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication, CCP, ECCP PWM programming of PIC18FXXX.

UNIT - IV PERIPHERAL INTERFACING (9)

Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADC and DAC, Stepper motors and DC Motors, I^2C, SPI with 8051 and PIC family.

UNIT - V MICROCONTROLLER APPLICATIONS (9)

Pulse measurement-measuring frequency, pulse width measurement -Speed control of DC Motor-Speed control of Stepper Motor-Traffic Light Controller and Washing Machine Controller.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

*1. Kenneth J.Ayala., **"The 8051 Microcontroller",** 3rd Edition, Thompson Delmar Learning, 2007, New Delhi.*

*2.John B. Peatman, "**PIC programming"**, McGraw Hill International, USA, 2005.*

***Reference Books**:*

1. *Muhammad Ali Mazidi and Janice GillispicMazdi, "**The 8051 Microcontroller and Embedded Systems**" Pearson Education, Inc 2006.*

*2 .John B. Peatman, "**Design with Micro controllers"**, McGraw Hill International, USA, 2005*

*3. James W. Stewart, **"The 8051 Micro controller hardware, software and interfacing**", regents Prentice Hall, 2003.*

*4. David Calcutt, Fred Cowan, Hassan Parchizadeh, "**8051 Microcontroller An Application Based Introduction"**, Elsevier Publication, 1st edition, 2004.*

*5.Krishna Kant, "**Microprocessor and Microcontrollers**" Eastern company edition, Prentice Hall of India, New Delhi, 2007.*

COURSE OUTCOMES:

Upon completion of this course the student will:

CO 1: Acquire knowledge on the basics of microcontroller

CO 2: Exposure to 8051 microcontroller Programming

CO 3: Exposure to PIC microcontroller Programming

CO 4: Able to interface peripherals with microcontrollers

CO 5: Get exposure to the applications of microcontrollers

CO 6: Able to design microcontroller based systems

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M									L	L	L	
CO2	M	H	M									M	M	M	
CO3	M	H	M									M	M	M	
CO4	M	H	M									M	M	M	
CO5	M	H	M									M	M	M	
CO6	H	H	H									M	H	H	
16LOEX14	M	H	M									M	M	M	

L-Low, M-Moderate (Medium), H-High

16NOEX15 INDUSTRIAL AUTOMATION SYSTEMS Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES

- To elaborate the basic concept of automation and the components required for automation.
- To introduce the concept and programming of programmable logic controllers and distributed control system which is used for process automation.
- To outline the basic concepts of SCADA technology.

UNIT - I INTRODUCTION TO AUTOMATION (9)

Automation overview – requirement of automation systems – architecture of industrial automation system – power supplies and isolators –relays – switches –transducers – sensors –seal-in circuits – industrial bus systems : modbus and profibus.

UNIT - II AUTOMATION COMPONENTS (9)

Sensors for temperature – pressure – force – displacement - speed – flow- level – humidity and pH measurement. Actuators – process control valves – power electronic drives DIAC- TRIAC – power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control

UNIT- III PROGRAMMABLE LOGIC CONTROLLERS (9)

PLC Hardware – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.

UNIT - IV DISTRIBUTED CONTROL SYSTEM (DCS) (9)

Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers

UNIT - V SCADA (9)

Introduction - Supervisory Control and Data Acquisition Systems (SCADA) – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

1. *John.W. Webb Ronald A Reis, "**Programmable Logic Controllers - Principles and Applications**", Prentice Hall Inc., 5th Edition, 2003.*
2. *M. P. Lukcas, "**Distributed Control Systems",** Van Nostrand Reinhold Co., 1986.*

Reference Books

*1. Bela G Liptak, **"Process software and digital networks – Volume 3",** 4th Edition, CRC press, 2012.*

*2. Frank D. Petruzella, "**Programmable Logic Controllers**", 5th Edition, McGraw Hill, 2016.*

*3. Huges T, "**Programmable Logic Controllers**", ISA press, 1994*

*4. Romily Bowden, "**HART application guide and the OSI communication foundation**", 1999*

*5. Krishna Kant, "**Computer Based Industrial Control**" Second edition, Prentice Hall of India, New Delhi, 2010*

COURSE OUTCOMES:

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

CO1: Elaborate the basic architecture of automation systems

CO2: Describe the various sensors and actuators involved in industrial automation

CO3: Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications

CO4: Illustrate the functionary components and supervisory control of DCS with relevant diagrams.

CO5: Describe the basics of SCADA technology

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
16NOEX15	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

L-Low, M-Moderate (Medium), H-High

16NOEX16 MEASUREMENTS AND INSTRUMENTATION

(*Common to all Branches)* **Category:OE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

16NPC305 Sensors and Transducer

COURSE OBJECTIVES

- To study about the electrical parameter measuring instruments.
- To familiarize about the measurement techniques for power and energy.
- To gain knowledge about potentiometer and instrument transformers.
- To learn about the working of different analog and digital instruments.
- To study about display and recording devices.

UNIT - I MEASUREMENT OF ELECTRICAL PARAMETERS (9)

Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments – Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods. Measurement of Inductance: Maxwell-Wien Bridge, Hay's bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.

UNIT - II POWER AND ENERGY MEASUREMENTS (9)

Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading – Single phase Induction type energy meter – 3 phase induction energy meter and phase measurement– Calibration of wattmeter and Energy meters – Synchroscope.

UNIT - III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS (9)

D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and Coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.

UNIT - IV ANALOG AND DIGITAL INSTRUMENTS (9)

Wave analyzers – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency measurement.

UNIT - V DISPLAY AND RECORDING DEVICES (9)

Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD and dot matrix displays – X-Y recorders – Magnetic tape recorders –Digital Data Recording –Digital memory waveform recorder – Data loggers.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1.Kalsi. H.S, "**Electronic Instrumentation**", Tata McGraw-Hill, New Delhi, 2010*

*2.Sawhney.A.K, "**A Course in Electrical & Electronic Measurements & Instrumentation**", Dhanpat Rai and Co., New Delhi, 2010*

Reference Books

*1.Northrop. R.B, "**Introduction to Instrumentation and Measurements**", Taylor & Francis, New Delhi, 2008.*

*2.Carr.J.J, "**Elements of Electronic Instrumentation and Measurement**", Pearson Education India, New Delhi, 2011.*

*3.David A.Bell, "**Electronic Instrumentation and Measurements**", PHI, New Delhi.*

*4.Copper. W.D and Hlefrick.. A.D, "**Modern Electronic Instrumentation and Measurement Technique"** 5th Edition, Prentice Hall of India, 2002.*

COURSE OUTCOMES:

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

CO1: Compare the working principles, merits and demerits of different types of electrical instruments and can understand about different instruments that are used for Measurement purpose.

CO2: Understand how different bridge networks are constructed and balanced for finding the values of resistance, capacitance and inductance.

CO3: Apply knowledge of electronic instrumentation for measurement of electrical quantities.

CO4: Apply the principles and practices for instrument design and development to real world problems.

CO5: Select a suitable measuring instrument for a given application.

CO6: Pursue higher studies and do research activities in the field of measurement and instrumentation.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO2	H	M	M	M	H	H	H	M	H	L	H	H	H	H	M
CO3	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H
CO4	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO5	H	H	M	H	M	H	M	L	H	M	H	H	H	M	M
CO6	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M
16NOEX16	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H

L-Low, M-Moderate (Medium), H-High

16SOEX17 **ENTERPRISE JAVA** **Category:OE**

(Common to all Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

Upon completion of this course, the students will be familiar with:

- Basic programming constructs in java to develop simple object oriented programs
- Enterprise Architecture types and features of Java EE platform
- JEE foundation concepts like Enterprise java bean,JSP and JSF
- Distributed Programs and methods to connect with database.
- Java Web services

UNIT- I INTRODUCTION TO JAVA (9)

Introduction to object oriented programming-Features of Java – Data types, variables and arrays – Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces – Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling – Networking –Applet class – Event Handling.

UNIT -II INTRODUCTION TO ENTERPRISE JAVA (9)

Challenges of Enterprise application Development - Platform for enterprise Solutions – J2EE Application Scenario - J2EE Platform Technologies –J2EE Multi-Tier Architecture - J2EE Architecture Approaches - Model-View-Controller Architecture - J2EE Design Patterns - Designing the Sample Application - Choosing Application Tiers - Choosing Local or Distributed Architecture - Architecture of the Sample Application

UNIT- III ENTERPRISE JAVA FOUNDATION (9)

Enterprise Java Beans -Business Logic and Business Objects. - Enterprise Beans as J2EE Business Objects - Entity Beans - Session Beans - Message-Driven Beans -Transaction support in EJB-Security support in EJB –Java Server Pages - Directive Elements - Scripting Elements - Action Elements-Expression Language-JSP Standard Tag Library - Java Server Page Online Store – JavaServer Faces - Life Cycle - Resource Management.

UNIT -IV INTERCONNECTIVITY (9)

Concept of JDBC – JDBC Driver types- Database Connection – Associating JDBC Bridge with the database – Statement Objects –Resultset – Transaction Processing – RMI- Network File-Locking Server -Java Mail API and Java Activation Framework – send ,receive, retrieve and delete email message - Java Message Service – JMS Fundamentals –Components of a JMS program -JMS architecture –JMS-Based Alarm System - JNDI – Naming and Directories – Naming Operations

UNIT -V WEB SERVICES (9)

SOAP Basics – Java API for XML Messaging – Creating a SOAP Attachment – Accessing a SOAP Attachment – Universal Description, Discovery and Integration (UDDI)- UDDI Architecture – UDDI Application Programming Interface – Inquiry Application Programming Interface – Publishing Application Programming Interface –JAXR – JAXR client – Publishing a service to an XML Registry – Removing a published service from an XML Registry- WSDL – Inside WSDL- WSDL and SOAP - RESTFul Web services – REST Approach - Java API for RESTful Web service

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1.Herbert Schildt, "**Java The Complete Reference**" , 9th Edition. Tata McGraw- Hill Edition. 2014.*

*2.Stephen Asbury and Scott R. Weiner "**Developing Java Enterprise Applications",** second edition Wiley Publishing.1999.*

*3.Antonio Goncalves "**Beginning Java™ EE 6 Platform with GlassFish™ 3From Novice to Professional**" Apress 2009.*

*4.Jim Keogh, "**The Complete Reference J2EE** " ,Tata McGraw –Hill 2002*

Reference Books

*1.John Brock,Arun Gupta,GeertjanWielenga "**Java Server Programming Java EE 7 (J2EE 1.7) - Black Book**" McGraw Hill, 2015.*

*2.Inderjeet Singh, Beth Stearns, Mark Johnson, and the Enterprise Team "**Designing Enterprise Applications with the J2EE™ Platform**", Second EditionAddison Wesley, 2002.*

COURSE OUTCOMES

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

CO1: Write simple java programs using fundamental concepts of java like control structures, inheritance, packages,interfaces,multithreaded programming and exception handling**. [Usage]**

CO2: Write java program for Networking using applets**.[Usage]**

CO3: Describe and use the client/server and distributed architectures in a programming environment**. [Usage]**

CO4: Use EJB, JSP and JFC technology in developing enterprise applications **[Usage]**

CO5: Apply Java interconnectivity techniques like JDBC, RMI, Java Mail, JMS , JNDI in developing enterprise applications**. [Usage]**

CO6: Explain the roles XML,JAXR, SOAP, WSDL and UDDI in the architecture of Web services **[Familiarity]**

CO7: Develop java program to use RESTful web services **[Assessment**].

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	L	M					L				L				
CO2	L	L	M	L	H			L				L	L	H		L
CO3	L	L	M	L	H			L				M	L	H	H	L
CO4	L	L	M	L	H	L	L	L	L	L	L	M	L	H	H	L
CO5	L	L	M	L	H			L				M	L	H		L
CO6		L	L									L		H	H	H
CO7	L	L	L	L	H			L	L	L	L	M	L	H	H	H
16SOEX17	L	L	M	L	L	L	L	L	L	L	L	M	L	H	M	L

L-Low, M-Moderate (Medium), H-High

16SOEX18 **CYBER SECURITY** **Category:OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Cybercrime and cyber offenses.
- Cybercrime using mobile devices.
- Tools and methods used in cybercrime.
- Legal perspectives of cybercrime.
- Fundamentals of computer forensics.

UNIT- I INTRODUCTION TO CYBERCRIME AND CYBEROFFENSES (9)

Cybercrime and Information Security - Classifications of Cybercrimes - The Legal Perspectives - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes - Plan of Attacks - Social Engineering – Cyberstalking - Cybercafe and Cybercrimes – Botnets - Attack Vector.

UNIT- II CYBERCRIME: MOBILE AND WIRELESS DEVICES (9)

Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era – Security challenges posed by mobile devices – registry setting for mobile devices – authentication service security – attacks on mobile/cell phones – Organizational measures for handling mobiles.

UNIT -III TOOLS AND METHODS USED IN CYBERCRIME (9)

Proxy Servers and Anonymizers – Phishing - Password Cracking – Keyloggers – Spywares -Virus and Worms - Trojan Horses and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Attacks on Wireless Networks.

UNIT -IV CYBERCRIMES AND CYBERSECURITY: THE LEGAL PERSPECTIVES (9)

Cyberlaws- The Indian Context - The Indian IT Act - Challenges to Indian Law and Cybercrime Scenario in India - Consequences of Not Addressing the Weakness in Information Technology Act - Digital Signatures and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment.

UNIT -V UNDERSTANDING COMPUTER FORENSICS (9)

Digital Forensics - Forensics Analysis of E-Mail - Network Forensics - Forensics and Steganography - Forensics and Social Networking Sites - Challenges in Computer Forensics - Data Privacy Issues – Forensics Auditing – Antiforensics

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Book

1.Nina Godbole and Sunit Belapur, ***"Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives"****, Wiley India Publications, April, 2011*

Reference Books

1.Robert Jones, ***"Internet Forensics: Using Digital Evidence to Solve Computer Crime",*** *O'Reilly Media, October, 2005.*

2.Chad Steel, ***"Windows Forensics: The field guide for conducting corporate computer investigations"****, Wiley India Publications, December, 2006.*

COURSE OUTCOMES:

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

CO1: Explain the fundamental concepts of cybercrime and cyberoffenses. **[Familiarity]**

CO2: Describe the cybercrimes occurred in mobile and wireless devices. **[Familiarity]**

CO3: Elaborate the methods used in cybercrime. **[Familiarity]**

CO4: Explain the laws for cybercrime and its respective punishments. **[Familiarity]**

CO5: Explain the forensics Analysis of E-Mail, Network and Social Networking Sites **[Familiarity]**

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	L	L	M	L	H						L	L	L	H	L
CO2	L	L	L	M	L	H						L	L	L	H	L
CO3	L	L	L	M	L	H						L	L	L	H	L
CO4	L	L	L	M	L	H						L	L	L	H	L
CO5	L	L	L	M	L	H						L	L	L	H	L
16SOEX18	L	L	L	M	L	H						L	L	L	H	L

L-Low, M-Moderate (Medium), H-High

16SOEX19 **NETWORK ESSENTIALS** **Category:OE**

(Common to all Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Basic taxonomy and terminology of the computer networking
- Wireless networking
- Addressing and Routing
- Routing protocols
- Troubleshooting and security issues.

UNIT -I INTRODUCTION (9)

Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics

UNIT -II WIRELESS NETWORKING (9)

Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation.

UNIT -III ADDRESSING AND ROUTING FUNDAMENTALS (9)

IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet.

UNIT- IV ROUTING PROTOCOLS (9)

Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP , DNS - Analyzing Internet Traffic.

UNIT -V TROUBLESHOOTING AND NETWORK SECURITY (9)

Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books

*1.Jeffrey S.Beasley Piyasat Nilkaew, "**Network Essentials**", 3rd Edition, Pearson, 2012.*

*2.Larry L. Peterson and Bruce S. Davie, "**Computer Networks, A Systems Approach**", Morgan Kaufmann Publishers Inc, 5th edition 2011.*

Reference Books

*1.Behrouz A.Ferouzan,**"Data Communications and Networking"**, 5th edition, Tata McGraw-Hill, 2012.*

*2.Andrew S. Tanenbaum, "**Computer networks**"s, PHI, 5th edition 2011.*

*3.William Stallings, "**Data and computer communication**", 10th edition, Pearson Education, 2013.*

COURSE OUTCOMES

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

- **CO1:** Identify topologies and types of Computer Networks **[Familiarity]**
- **CO2:** Enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer **[Familiarity]**
- **CO3:** Identify and Compare types of cabling for data communication **[Usage]**
- **CO4:** Explain the significance of wireless networks **[Familiarity]**
- **CO5:** Configure a Wireless LAN **[Assessment]**
- **CO6:** Configure router and a switch **[Assessment]**
- **CO7:** Describe basic routing algorithms and network services. **[Usage]**
- **CO8:** Troubleshoot the router and switch interface **[Usage]**
- **CO9**: Analyze Campus Network data traffic **[Usage]**

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	H	H				H	H	H	H	M	H	H	M
CO2	H	H	H	H	H				H	H	H	H	M	H	H	M
CO3	L	L	L	L	H				L	L	L	H	M	H	H	M
CO4	L	H	M		H				H	M	L	H	L	H	H	L
CO5	H	H	H	M	H				H	H	M	H	M	H	H	M
CO6	H	H	H	M	H				H	M	L	H	M	H	H	M
CO7	H	H	H	H	H				H	H	M	H	M	H	H	M
CO8	H	H	H	M	H				H	M	L	H	M	H	H	M
CO9	H	H	H	M	H				H	H	M	H	M	H	H	M
16SOEX19	M	H	H	M	H				H	M	M	H	M	H	H	M

L-Low, M-Moderate (Medium), H-High

16IOEX20 **PROGRAMMING IN PYTHON** **Category:OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course the students will be Familiar with:

- Data types and variables declaration
- Control statements, Functions and the use of basic programming.
- List, dictionary and functions used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

UNIT -I INTRODUCTION (9)

Introduction to Python - Setting up Python in OS – Python IDLE(write- edit- run- and save programs) – Strings - Numbers – Variables – simple I/O - Getting user input– Using String method–Converting values.

UNIT -II CONTROL STATEMENTS AND FUNCTIONS (9)

Control statements – Random number generator- Branching and loops – Range functions- Functions – User defined functions- passing parameters- return function- working withglobal variables and constants.

UNIT -III LISTS AND DICTIONARIES (9)

Lists – create- index- slice a list- Add and delete elements from a list- Append- Sort and reverse a list- nested sequences- Dictionaries – Create- add- delete from a Dictionary- Operations associated with pairs of data.

UNIT -IV FILES AND EXCEPTIONS (9)

Files – Read from text files- Write to text files- Read and write more complex data- Exceptions – Intercept and handle errors during program's execution.

UNIT -V OBJECT ORIENTED PROGRAMMING AND GUI (9)

Object oriented programming – Create objects of different classes in the same program- objects communication- complex object creation- derive new classes- existing class extension- override method- GUI – GUI toolkit- create and fill frames- create buttons- text entries and text boxes- create check buttons and radio buttons - case study – create a web page using GUI functionality

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books

1.Y. Daniel Liang ***"Introduction to Programming Using Python",*** *Pearson, 2013.*

2.Charles Dierbach ***"Introduction to Computer Science Using Python: A Computational Problem-Solving Focus"****, Wiley Publications, 2012.*

Reference Books

*1.Michael Dawson "****Python Programming for the Absolute Beginner"****, Premier Press, 2003.*

COURSE OUTCOMES

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

CO1: Use various data types. [**Understand**]

CO2: Handle the arrangement of data elements in Lists and Dictionary structures.[**Analyze**]

CO3: Use control statements and functions. [**Understand**]

CO4: Handle exceptions and perform file operations**. [Understand]**

CO5: Develop application using object oriented programming and GUI. [**Analyze**]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L		L	L		L	L			L		L	L
CO2	M	L		L	L		L	L			L		L	L
CO3	M	M	L	M	L		L	L			L		M	L
CO4	M	M	L	M	L		M	M			L		M	L
CO5	M	M	L	M	L		M	M			M	L	M	L
16IOEX20	M	M	L	M	L		L	L			L	L	M	L

L-Low, M-Moderate (Medium), H-High

16IOEX21 **BIG DATA SCIENCE** **Category:OE**

(Common to all Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Big Data and its characteristics
- Technologies used for Big Data Storage and Analysis
- Mining larger data streams
- Concepts related to Link analysis and handle frequent data sets

UNIT- I THE FUNDAMENTALS OF BIG DATA (9)

Understanding Big Data-Concepts and Technology-Big Data Characteristics-Types of data-Case Study-Business Motivation and Drivers for Big Data Adoption- Planning Considerations-Enterprise Technologies and Big Data Business Intelligence- OLTP-OLAP-Extract Transform Load-Data Warehouses-Data Mart-Traditional and Big Data BI-Case Study

UNIT -II BIG DATA STORAGE AND PROCESSING (9)

Big Data Storage Concepts- Clusters-File systems and Distributed File Systems-NoSQL- Sharding -Replication -Sharding and Replication-CAP Theorem-ACID-BASE-Case Study- Big Data Processing Concepts- Parallel Data Processing-Distributed Data Processing-Hadoop-Processing Workloads-Cluster-Processing in Batch mode-Processing in RealTime mode-Case study

UNIT -III BIG DATA STORAGE AND ANALYSIS TECHNOLOGY (9)

Big Data Storage Technology: On-Disk Storage devices-NoSQL Databases-In-Memory Storage Devices-Case study, Big Data Analysis Techniques: Quantitative Analysis-Qualitative Analysis-Data Mining-Statistical Analysis-Machine Learning-Semantic Analysis-Visual Analysis-Case Study

UNIT -IV MINING DATA STREAMS (9)

The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- dis tance measures – methods for high degree similarity.

UNIT -V LINK ANALYSIS AND FREQUENT ITEMSETS (9)

Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – A-Priori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books

1. *Thomas Erl, WajidKhattak, and Paul Buhler,"* ***Big Data Fundamentals Concepts, Drivers & Techniques"****, Prentice Hall,2015*
2. *AnandRajaraman and Jeffrey David Ullman,* ***"Mining of Massive Datasets****", Cambridge University Press, 2012.*

Reference Books

1.Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, ***"Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data"***, *McGraw Hill, 2011.*

2.Frank J Ohlhorst, ***"Big Data Analytics: Turning Big Data into Big Money",*** *Wiley and SAS Business Series, 2012.*

3.Brian W. Kernighan and Dennis Ritchie, ***"The C Programming Language",*** *Second Edition, Prentice Hall Software Series, 1988.*

4.Stephen Prata, ***"C Primer Plus****", Fifth Edition, Sams Publishing, 2005.*

COURSE OUTCOMES

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

CO1: Understand the Big Data and usage in Enterprise Technologies. [Understand]

CO2: Store and Process Big Data using suitable Processing Methods[Understand]

CO3: Handle Big Data using appropriate analysis Techniques. [Analyse]

CO4: Mine larger data streams using suitable algorithms. [Understand]

CO5: Rank pages and handle large data sets efficiently [Analyse]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	M	L	H	L							H	L
CO2	M				H			L					M	L
CO3		H			H								H	
CO4	M	H	M		M								H	
CO5	L	M	H										H	
16IOEX21	M	M	L	L	M	L		L					H	L

L-Low, M-Moderate (Medium), H-High

16IOEX22 OBJECT ORIENTED PROGRAMMING USING C++ Category:OE

(Common to all Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Fundamentals of object oriented programming
- Classes and objects
- Concepts of overloading and type conversions
- Inheritance and Polymorphisms
- Files, templates and exception handling

UNIT -I PRINCIPLES OF OBJECT ORIENTED PROGRAMMING (9)

Basic concepts- benefits – applications of object oriented programming – beginning with C++ - tokens – expressions and control structures – C++ stream classes – Formatted and Unformatted I/O operations. Managing output with manipulators.

UNIT -II CLASSES AND OBJECTS (9)

Introduction – specifying class – defining member functions – memory allocation constructors and destructors:- parameterized- copy – default -dynamic and multiple constructors – destructors

UNIT -III FUNCTIONS AND TYPE CONVERSIONS (9)

Introduction – function prototyping call by reference – return by reference – inline function – recursion – friend function – function overloading – operator overloading – manipulation of strings using operators – type conversions

UNIT -IV INHERITANCE AND POLYMORPHISM (9)

Defining derived classes – single, multiple, multilevel, hierarchical and hybrid inheritance – virtual base classes – abstract base classes – nesting of classes - pointers – pointers to objects – this pointer – pointers to derived classes – virtual functions – pure virtual functions virtual constructors and destructors.

UNIT -V FILES AND TEMPLATES (9)

Classes for file stream operations – opening and closing a file – detecting EOF – open file modes – file pointers and their manipulations – sequential I/O operations – updating and error handling of file. Class and function template – template with multiple parameters – overloading, member function and non-type template arguments-Exception handling.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1.E.Balagurusamy **"Object oriented Programming with C++"** McGraw Hill Education Ltd,6th Edition 2013.*

Reference Books

*1.R.Rajaram **"Object Oriented Programming and C++"** New Age International 2nd edition , 2013*

*2.K.R. Venugopal,Rajkumar,T. Ravishankar **"Mastering C++"** , Tata McGraw Hill Education,2nd edition, 2013*

*3.Yashavant P. Kanetkar**" Let us C++"** BPB Publications , 2nd edition 2003.*

COURSE OUTCOMES

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

CO1: Understand the principles of object oriented programming [Understand]
CO2: Develop programs using classes and objects.[Analyze]
CO3: Use functions and type conversions in programs. [Understand]
CO4: Apply inheritance and polymorphism to develop applications. [Analyze]
CO5: Use files, templates and handle exceptions. [Understand]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	H	H	M	M		M	M			M		M	M
CO2	M	H	H	H	M		M	M			M		H	M
CO3	M	H	H	H	M		M	M			M		H	M
CO4	M	H	H	H	M	L	M	M			M		H	M
CO5	M	H	H	H	M		M	M			M		H	M
16IOEX22	M	H	H	H	M	L	M	M			M		H	M

L-Low, M-Moderate (Medium), H-High

16BOEX23 **COMPUTATIONAL BIOLOGY** **Category:OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Understand the basic concepts and role of computation in biological analysis
- Familiarize with sequence alignment methods
- Understand the machine learning tools used for biological analysis

UNIT -I BASICS OF BIOLOGY **(9)**

Biomolecules of life:Structure and Composition of DNA, RNA & Protein.Protein Structure basics-Primary, Secondary and tertiary Structure of protein

UNIT -II BIOLOGICAL DATABASES **(9)**

Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI,EMBL,DDBJ; Structure databases-PDB

UNIT -III SEQUENCE ANALYSIS **(9)**

Pairwise alignment tools-Dot matrix analysis, Dynamic programming-Smith waterman and Needleman wunsch algorithm ,Heuristic methods- BLAST,FASTA;Multiple sequence alignment methods-Progressive alignment(Clustal)

UNIT -IV STRUCTURE ANALYSIS AND DRUG DESIGN **(9)**

Protein secondary prediction-Chou fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.

UNIT -V MACHINE LEARNING **(9)**

Genetic Algorithm, Neural networks,Artificial Intelligence, Hidden markov model -application in bioinformatics

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books

*1.David W. Mount, **"Bioinformatics: Sequence and Genome Analysis"**, Cold Spring Harbor Laboratory Press, Second Edition, 2004.*

*2 Arthur M. Lesk, **"Introduction to Bioinformatics",**Oxford University Press, 2008.*

*3.Pierre Baldi, Soren Brunak , **"Bioinformatics: The machine learning approach"** MIT Press, 2001*

Reference Books

*1.Andrew R. Leach, "**Molecular Modeling Principles And Applications",** Second Edition, Prentice Hall, 2001.*

*2.Baxevanis A.D. and Oullette, B.F.F, **"A Practical Guide to the Analysis of Genes and Proteins",** 2nd ed., John Wiley, 2002*

*3.David L. Nelson ,Michael M. Cox , **"Lehninger Principles of Biochemistry"**, Sixth edition, Freeman, W. H. & Co. Publisher,2012.*

COURSE OUTCOMES

Upon completion of the Computational Biology course, the students will be able to

CO1: Understand basic structure of Biological macromolecules
CO2: Acquire the knowledge of biological databases
CO3: Ability to perform pair wise and multiple sequence alignment
CO4: Ability to predict the secondary and tertiary structure of proteins.
CO5: Understand the machine learning approaches in computational biology

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L		L			M				M		
CO2	M	L	L	L					L			L	L		
CO3	L		L			M			L			L		M	
CO4	M	M	L	M	M								L	L	
CO5		M		H	H	M	L		M				L	M	
16BOEX23	L	L	L	L	L	L	L		L			L	L	L	

L-Low, M-Moderate (Medium), H-High

16BOEX24 **BIOLOGY FOR ENGINEERS** **Category:OE**

(Common to all Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students

- To understand the basic functions of the cell and their mechanisms in transport process
- To get familiarize human anatomy and physiology
- To learn about microbes, immune system and biomolecules
- To know the concepts of applied biology

UNIT -I BASICS OF CELL BIOLOGY (9)

An Overview of cells – Origin and evolution of cells. Cell theory, Classification of cells – prokaryotic cells and eukaryotic cells. Structure of prokaryotic and eukaryotic cells and their organelles. Comparison of prokaryotic and eukaryotic cells, Transport across membranes – diffusion - active and passive diffusion.

UNIT -II BASICS OF MICROBIOLOGY (9)

Classification of microorganism, Microscopic examination of microorganisms, Structural organization and multiplication of bacteria, viruses, algae and fungi, Microorganism used for the production of penicillin, alcohol and vitamin B-12.

UNIT- III HUMAN ANATOMY AND PHYSIOLOGY (9)

Basics of human anatomy, tissues of the human body: epithelial, connective, nervous and muscular, Nervous system, Respiratory System, Circulatory system and Digestive system.

UNIT- IV BIO MOLECULES AND IMMUNE SYSTEM (9)

Introduction to Biochemistry, Classification, structure and properties of carbohydrates, proteins, lipids and nucleic acids. Innate and acquired immunity, Types of immune responses.

UNIT -V APPLIED BIOLOGY FOR ENGINEERS (9)

Overview of biosensors- glucometer applications-medicine, Microarray analysis to diagnose the cancer, Microbial production of biofuels, Applications of stem cells.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

1.Darnell J, Lodish H, Baltimore D, ***"Molecular Cell Biology",*** *W.H.Freeman; 8th edition,2016*

*2.Pelczar MJ, Chan ECS and KreinNR****,"Microbiology"****, Tata McGraw Hill, 5th edition, New Delhi.2001.*

3.WulfCruger and AnnelieseCruger, ***"A Textbook of Industrial Microbiology"****, Panima Publishing Corporation, 2nd Edition, 2000.*

Reference Books

1.David L. Nelson and Michael M Cox, ***"Lehninger'sPrinciples of Biochemistry"****, Macmillan Worth Publisher, 4th edition, 2004.*

*2.Brain R.Eggins ,****"Chemical Sensors and Biosensors"****, John Wiley & Sons, 2002*

3.Anton Moser, ***"Bioprocess Technology, Kinetics and Reactors"*** *Springer, Berlin (Verlag),1998*

4.Kuby J, **"Immunology"**, WH Freeman & Co., 2000.

COURSE OUTCOMES

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

CO1: Understand the functions of cell and their structural organization

CO2: Describe the mechanisms and role of cell in immune system

CO3: Get familiarized biomolecules and human anatomy system

CO4: Illustrate the applications of microbes in industrial process

CO5: Apply the engineering concepts in biology

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L		L	M		L		L	M	L	L	L	
CO2	L		L	L	L	M	M		L	L	L	L	L	L	
CO3	L	L			L	L	L	L	L		L	L	L	L	
CO4	L		L		L			L		L	L	L	L	M	
CO5															
16BOEX24	L	L	L	L	L	L	L	L	L	L	L	L	L	L	

L-Low, M-Moderate (Medium), H-High

16BOEX25 FUNDAMENTALS OF BIOENGINEERING Category:OE

(Common to all Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students aware of the overall industrial bioprocess.
- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

UNIT - I INTRODUCTION TO INDUSTRIAL BIOPROCESS (9)

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.

UNIT - II FERMENTATION INDUSTRY (9)

Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.

UNIT - III PRODUCTION OF PRIMARY METABOLITES (9)

A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol.

UNIT - IV PRODUCTION OF SECONDARY METABOLITES (9)

Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12

UNIT - V PRODUCTS THROUGH MODERN BIOTECHNIQUES (9)

Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1.Peter F. Stanbury, Stephen J. Hall & A. Whitaker, **"Principles of Fermentation Technology"**, Science & Technology Books. 1995.*

*2.Presscott, S.C. and Cecil G. Dunn, **"Industrial Microbiology"**, Agrobios (India), 2005.*

*3.Casida, L.E. **"Industrial Microbiology"**, New Age International (P) Ltd, 1968.*

Reference Books

*1.Crueger, W and AnnelieseCrueger, Biotechnology: **"A Textbook of Industrial Microbiology"**, Panima Publishing Corporation, Edition 2, 2003*

*2.Sathyanarayana, U., **"Biotechnology"**, Books and Allied (P) Ltd. Kolkata, 2005*

*3.Ratledge C and Kristiansen B. **"Basic Biotechnology"**, Cambridge University Press, second Edition, 2001.*

*4.Michael J. Waites. **"Industrial Microbiology:** An Introduction", Blackwell Publishing,2001.*

COURSE OUTCOMES

CO1: Upon completion of the course in Bioprocess Principles graduates will be able to understand the basics of industrial bioprocess.

CO2: Explain the principle of a fermentation process and the chronological development of fermentation industry.

CO3: Understand the basic configuration of a fermentor and its ancillaries.

CO4: Learn the production of various primary and secondary metabolites.

CO5: Understand the production of biotechnological products.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	H										M		
CO2	H	M													
CO3	H	H	H	M	M	M		L	H					H	
CO4	H	L	L			L		L						H	
CO5	H	M	H	L	M			L						H	
16BOEX25	H	M	M	L	L	L		L	L				L	M	

L-Low, M-Moderate (Medium), H-High

16COC1Z1 **HUMAN VALUES I** **Category : OC**

Common to all branches

L T P C

1 0 0 1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Essential complementarily between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- The development of a Holistic perspective among students towards life, profession and happiness based on a correct understanding of the Human reality and the rest of existence, which forms the basis of Value based living in a natural way.
- The plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with nature.

UNIT I INTRODUCTION TO VALUE EDUCATION 5 Periods

Introduction- Need, Basic Guidance, Content and Process for Value Education- Basic human Aspirations – Prosperity and happiness – Methods to fullfill human aspirations - Understanding and living in harmony at various levels.

UNIT II HARMONY IN THE HUMAN BEING 5 Periods

Coexistence – Happiness and convenience – Appraisal of Physical needs – Mental and Physical health – Human relationship – Mutual Trust and Respect.

UNIT III ETHICS 5 Periods

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue – Caring – Sharing - honesty- Courage – Empathy – Self Confidence -Ethical Human Conduct- Basis for humanistic Education, Constitution and universal order – Competence in professional ethics – Strategy for transition from the present state to Universal human order.

CONTACT PERIODS:

Lecture: 15 Periods Tutorial:0 Periods Practical: 0 Period Total: 15 Periods

Text Books:

1. R.R. Gaur, R. Singal, G.P. Bangaria, "Foundation Course in Human Values and Professional Ethics", 2009, Excel Book Private Ltd., New Delhi.

Reference Books:

1. S. K. Chakraborty and Dabangshu Chakraborty, "Human Values and Ethics: Achieving Holistic Excellence", ICFAI University Press, 2006.

2. A.N. Tripathy, "Human Values", New Age International publishers, 2003.

3. M. Govindarajan, S. Natarajan and V.S. Senthil kumar, "Engineering Ethics"(including human values), Eastern Economy Edition, Printice Hall of India Ltd., 2004.

4. E.G. Seebauer and Rober. L. Berry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2000.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Start exploring themselves, get comfortable to each other and to the teacher and start finding the need and relevance for the course.

CO2: See that their practice in living is not in harmony with their natural acceptance most of the time and able to refer to their natural acceptance to remove this disharmony.

CO3: Aware of their activities like understanding, desire,thought and selection and start finding their focus of attention at different moments.

CO4: Able to see that respect is right evaluation and only right evaluation leads to fulfillment in relationship.

CO5: Develop an understanding of the whole existence and interconnectedness in nature.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M	L			L	L	H	M	M	L	L		L	M	L
CO2	L	M	H			L	L	H	M	L	L	L		L	M	L
CO3	L	M				M	L	H	L	H	M	M		L	M	L
CO4	L	M	M			M	H	H	M	M	H	H		L	M	L
CO5	L	M				H	L	H	M	L	H	H		L	M	L
16COC1Z1	L	M	L			M	L	H	M	M	M	H		L	M	L

L-Low, M-Moderate (Medium), H-High

16COCX02 HUMAN VALUES AND PROFESSIONAL ETHICS **Category : OC**

Common to all branches

L T P C
1 0 0 1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Engineering Ethics and Human Values
- Social responsibility of an Engineer
- Ethical dilemma while discharging duties in Professional life.

UNIT I ENGINEERING ETHICS 5 Periods

Senses of Engineering Ethics -variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's Theory – Gilligen's Theory – Consensus and contraversy – Models of Professional roles – theories about right actions – Self interest – customs and religion – uses of ethical theories – Valuing time-cooperation-commitment.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 5 Periods

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

UNIT III SAFTY, RESPONSIBLITIES, RIGHTS AND GLOBAL ISSUES 5 Periods

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the three mile island and chernobyl case studies.– Environmental ethics – computer ethics – weapons development- Multinational corporations - engineers as expert witnesses and advisors.

CONTACT PERIODS:

Lecture:15 Periods Tutorial:0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

1.Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York,1996.

2.M. Govindarajan,S. Natarajan and V.S. Senthil kumar, "Engineering Ethics" (including human values), Eastern Economy Edition, Printice Hall of India Ltd., 2004.

Reference Books:

1. Charles D.Fleddermann, "Engineering Ethics", Pearson Education, 2004.

2. Edmund G Seebauer and Robert L. Berry, "Fundamentals of Ethics for Scientists and Engineers", 2001, Oxford University Press

3. Charles E. Harris, Michael S. Protchard and Michael J. Rabins, "Engineering Ethics" – Concepts and Cases, Thomson Learning, 2000.

4. John R. Boatright, "Ethics and Conduct of Business", Pearson Education,2003.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Understand and appreciate Human values, exhibit self confidence and develop good character

CO2: Sense engineering ethics, professional roles and valuing time, co-operation and commitment

CO3: Understand and practise code of ethics.

CO4: Assess safety and risk and capable of doing risk benefit analysis.

CO5: Develop and exhibit moral leadership qualities in exercising Engineering Consultations without compromising envionmental, legal and ethical issues.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M	L			L		H	L		M	L		L	M	L
CO2	L	M	H			M		H	L		M	M		L	M	L
CO3	L	M				M		H	L		M	M		L	M	L
CO4	L	M	M			L		H	L		M	H		L	M	L
CO5	L	M				L		H	L		M	L		L	M	L
16COC202	L	M	L			L		H	L		M	M		L	M	L

L-Low, M-Moderate(Medium), H-High

16COCX03 **YOGA FOR YOUTH EMPOWERMENT** **Category : OC**

Common to all branches

L T P C
1 0 0 1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with

- To create awareness and the benefits of yoga and meditation
- To study and analyze the influential factors, which affect the engineering students healthy life

UNIT I PHYSICAL STRUCTURE AND ITS FUNCTIONS 5 Periods

Yoga – pur[ose of life, philosophy of life, physical structures, importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, cody relaxation.

UNIT II YOGASANAS 5 Periods

Rules & Regulations – asana, pranayama, mudra, bandh

UNIT III MIND 5 Periods

Bio magnetism & mind – imprinting & magnifying-eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of moditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity, Simplified Kundalini yoga: Agna, Santhi, thuriam, thuriyatheetham.

CONTACT PERIODS:

Lecture: 15 Periods Tutorial:0 Periods Practical: 0 Period Total: 15 Periods

Text Books:

1.Yoga for Modern Age – Vthathiri Maharashi
2.Mind – Vethathiri Maharashi

COUSE OUTCOMES:

Upon comp[letion of this course, the student will be able to,

CO1: YOGA which gives healthy & better living, Physical , Mental mood, Intellectual & spiritual.
CO2: work skillfully and perfectly to towards the excellence.
CO3: Achieve meditation practices, which strengthen the mind and increase the will power, concentration, creativity and ultimately to transform mid\nd to achieve self – realization.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	H							H						
CO2	M	H	M							M						
CO3	H	M								L						
CO4	H	H	M			M				M	M					
CO5	M	M	M													
16COC603	H	M	M			M				M	M					

L-Low, M-Moderate(Medium), H-High