PROGRAM STRUCTURE

AND

DETAILED SYLLABUS (Volume – II)

CIVIL ENGINEERING

FOR

CBCS BASED B.TECH FOUR YEAR DEGREE PROGRAM

(Applicable for the batches admitted from the AY 2016-17)

GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY

AN AUTONOMOUS INSTITUTION

Cheeryal (V), Keesara (M), Medchal (Dist.), Telangana – 501301

(Affiliated to JNTU, Hyderabad/ AICTE Approved / UGC Autonomous/ NAAC 'A' Grade)

Geethanjali College of Engineering and Technology (Autonomous)
Cheeryal (V), Keesara (M), Medchal Dist., Telengana-501301

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Department of Civil Engineering   **i**

Geethanjali College of Engineering and Technology (Autonomous)
Cheeryal (V), Keesara (M), Medchal Dist., Telengana-501301

Geethanjali College of Engineering and Technology (Autonomous)
Cheeryal (V), Keesara (M), Medchal Dist., Telengana-501301
SCHEME OF INSTRUCTION AND EXAMINATION
B.Tech. CIVIL ENGINEERING

Academic Regulations: AR 16

PROGRAM STRUCTURE

FIRST YEAR – SEMESTER I

Sl. No.	Course Code	Course	Category	No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Tot	C
1	16EN1101	English-I	HS	2	-	-	30	70	100	2
2	16PH1101	Engineering Physics	BS	3	1	-	30	70	100	3
3	16MA1101	Mathematics – I	BS	4	1	-	30	70	100	4
4	16CS1102	Introduction to Computer Programming	ES	3	-	-	30	70	100	3
5	16ME1101	Engineering Drawing	ES	2	-	3	30	70	100	4
6	16ME1102	Engineering Mechanics – I	ES	2	1	-	30	70	100	2
7	16PH11L1	Engineering Physics Lab	BS	-	-	3	30	70	100	2
8	16CS11L2	Computer Programming Lab	ES	-	-	3	30	70	100	2
9	16WS11L1*	Engineering Workshop (EWS) / Information Technology Workshop (ITWS)	ES	-	-	3	30	70	100	2
		Total		16	3	12	270	630	900	24
		Total Periods Per Week			31					

*ME BoS specified the syllabus for EWS while CSE BoS specified the syllabus for ITWS.

Abbreviation	Description	Abbreviation	Description
HS	Humanities and Social Sciences	L	Lecture
BS	Basic Sciences	T	Tutorial
ES	Engineering Sciences	P	Practical
PC	Professional Core	D	Drawing
PE	Professional Elective	CIE	Continuous Internal Evaluation
SC	Soft Core	SEE	Semester End Examination
OE	Open Elective	Tot	Total
CC	Core Course	C	Number of Credits

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FIRST YEAR – SEMESTER II

Sl. No.	Course Code	Course	Category	No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Tot	C
1	16EN1201	English –II	HS	2	-	-	30	70	100	2
2	16PH1203	Physics for Engineers	BS	3	1	-	30	70	100	3
3	16MA1201	Mathematics – II	BS	3	1	-	30	70	100	3
4	16CH1201	Engineering Chemistry	BS	3	-	-	30	70	100	3
5	16CH1202	Environmental Studies	HS	3	-	-	30	70	100	3
6	16ME1201	Engineering Mechanics – II	ES	2	1	-	30	70	100	2
7	16EE1201	Basic Electrical and Electronics Engineering	ES	3	1	-	30	70	100	3
8	16EN12L2	English Lab	HS	-	-	2	30	70	100	1
9	16CH12L1	Engineering Chemistry Lab	BS	-	-	3	30	70	100	2
10	16HS12L1	Gender Sensitization	HS	-	-	3	30	70	100	2
			Total	**19**	**4**	**8**	**300**	**700**	**1000**	**24**
		Total Periods Per Week		**31**						

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SECOND YEAR – SEMESTER I

Sl. No.	Course Code	Course	Category	No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Tot	C
1	16MA2102	Mathematics – III	BS	3	-	-	30	70	100	3
2	16CE2101	Building Materials, Construction & Planning	PC	3	-	-	30	70	100	3
3	16CE2102	Strength of Materials -I	ES	4	1	-	30	70	100	4
4	16CE2103	Surveying	PC	4	1	-	30	70	100	4
5	16CE2104	Fluid Mechanics	PC	4	1	-	30	70	100	4
6	16CE21L1	Strength of Materials Lab	ES	-	-	3	30	70	100	2
7	16CE21L2	Surveying Lab	PC	-	-	3	30	70	100	2
8	16MA21L1	Computational Mathematics Lab	BS	-	-	3	30	70	100	2
			Total	**18**	**3**	**9**	**240**	**560**	**800**	**24**
		Total Periods Per Week		**30**						

SECOND YEAR – SEMESTER II

Sl. No.	Course Code	Course	Category	No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Tot	C
1	16MA2201	Probability and Statistics	BS	4	1	-	30	70	100	4
2	16CE2201	Engineering Geology	PC	3	-	-	30	70	100	3
3	16CE2202	Concrete Technology	PC	3	-	-	30	70	100	3
4	16CE2203	Strength of Materials -II	PC	4	1	-	30	70	100	4
5	16CE2204	Hydraulics & Hydraulic Machinery	PC	4	1	-	30	70	100	4
6	16CE22L1	Engineering Geology Lab	PC	-	-	3	30	70	100	2
7	16CE22L2	Concrete Technology Lab	PC	-	-	3	30	70	100	2
8	16CE22L3	Fluid Mechanics & Hydraulic Machinery Lab	PC	-	-	3	30	70	100	2
			Total	**18**	**3**	**9**	**240**	**560**	**800**	**24**
		Total Periods Per Week		**30**						

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THIRD YEAR – SEMESTER I

Sl. No.	Course Code	Course	Category	No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Tot	C
1	16CE3101	Structural Analysis	PC	4	1	-	30	70	100	4
2	16CE3102	Design of Reinforced Concrete Structures	PC	4	1	-	30	70	100	4
3	16CE3103	Engineering Hydrology	PC	3	1	-	30	70	100	3
4	16CE3104	Transportation Engineering	PC	4	1	-	30	70	100	4
5	16CE3105	Geotechnical Engineering	PC	3	1	-	30	70	100	3
6	16CE31L1	Transportation Engineering Lab	PC	-	-	3	30	70	100	2
7	16CE31L2	Geotechnical Engineering Lab	PC	-	-	3	30	70	100	2
8	16EN31L1	Advanced English Communication Skills Lab	HS	-	-	3	30	70	100	2
			Total	**18**	**5**	**9**	**240**	**560**	**800**	**24**
		Total Periods Per Week		**32**						

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THIRD YEAR – SEMESTER II

Sl. No.	Course Code	Course	Category	L	T	P/D	CIE	SEE	Tot	C
				No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
1	16CE3201	Design of Steel Structures	PC	3	1	-	30	70	100	3
2	16CE3202	Foundation Engineering	PC	3	1	-	30	70	100	3
3	16CE3203	Environmental Engineering	PC	3	1	-	30	70	100	3
4	16CE3204	Irrigation Engineering	PC	3	1	-	30	70	100	3
5	**Open Elective – I**		OE	3	-	-	30	70	100	3
	16MB3221	Intellectual Property Rights								
	16EE3222	Industrial Safety and Hazards								
	16CS3223	JAVA Programming								
	16EC3224	Electronic Measuring Instruments								
	16ME3225	Nano Materials and Technology								
6	**Soft Core – I**		SC	3	1	-	30	70	100	3
	16CE3205	Geographic Information System								
	16CE3206	Advanced Structural Design								
7	16CE32L1	Environmental Engineering Lab	PC	-	-	3	30	70	100	2
8	**Soft Core - I Lab**		SC	-	-	3	30	70	100	2
	16CE32L2	Geographic Information System Lab								
	16CE32L3	Advanced Structural Design Lab								
9	16MB32P1	Human Values and Professional Ethics	HS	-	-	3	30	70	100	2
		Total		**18**	**5**	**9**	**270**	**630**	**900**	**24**
		Total Periods Per Week		**32**						

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FOURTH YEAR – SEMESTER I

Sl. No.	Course Code	Course	Category	L	T	P/D	CIE	SEE	Tot	C
				No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
1	16CE4101	Estimation, Costing & Contracts	PC	3	1	-	30	70	100	3
2	**Professional Elective – I**		PE	3	1	-	30	70	100	3
	16CE4102	Advanced Structural Analysis								
	16CE4103	Air & Water Transportation								
	16CE4104	Ground Improvement Techniques								
	16CE4105	Hydropower Engineering								
3	**Professional Elective – II**		PE	3	1	-	30	70	100	3
	16CE4106	Prestressed Concrete and Precast Structures								
	16CE4107	Health Monitoring and Retrofitting of Structures								
	16CE4108	Solid Waste Management								
	16CE4109	Groundwater Development and Management								
4	**Open Elective – II**		OE	3	-	-	30	70	100	3
	16MB4131	Supply Chain Management								
	16CS4132	Knowledge Management								
	16EE4133	Energy Conservation and Management								
	16EC4134	Basics of Communication Systems								
	16ME4135	Manufacturing Processes								
5	**Open Elective – III**		OE	3	-	-	30	70	100	3
	16MB4141	Banking and Insurance								
	16CS4142	Database Systems								
	16EE4143	Micro-Electro-Mechanical Systems								
	16EC4144	Principles of Wireless Communication Systems								
	16ME4145	Aspects of Heat Transfer in Electronically Controlled Units								
	16EN4147	Foreign Language - French								
	16EN4148	Foreign Language - Spanish								
	16EN4149	Foreign Language -German								
6	**Soft Core –II**		SC	3	1	-	30	70	100	3
	16CE4110	Finite Element Methods for Civil Engineering								
	16CE4111	Pavement Analysis and Design								
7	16CE41L1	Computer Aided Structural Drafting Laboratory	PC	-	-	3	30	70	100	2
8	**Soft Core - II Lab**		SC	-	-	3	30	70	100	2
	16CE41L2	FEM for Civil Engineering Lab								
	16CE41L3	Pavement Analysis and Design Lab								
9	16CE4112	Industry Oriented Mini-project	CC	-	-	-	--	100	100	1
10	16CE4113	Major Project Seminar	CC	-	-	2	100	--	100	1
		Total		18	4	8	340	660	1000	24
		Total Periods Per Week		30						

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FOURTH YEAR – SEMESTER II

Sl. No.	Course Code	Course	Category	No. of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Tot	C
1	16CE4201	Construction Technology & Project Management	PC	4	-	-	30	70	100	4
2	**Professional Elective – III**		PE	3	1	-	30	70	100	3
	16CE4202	Structural Dynamics								
	16CE4203	Soil Dynamics and Machine Foundation								
	16CE4204	Environmental Impact Assessment & Management								
	16CE4205	Railway Engineering								
3	**Open Elective – IV**		OE	3	-	-	30	70	100	3
	16MB4251	Entrepreneurship								
	16CS4252	Web Development								
	16EE4253	Renewable Energy Sources								
	16EC4254	Biomedical Instrumentation								
	16ME4255	Materials Handling								
	16MA4257	Actuarial Statistics								
4	16CE4206	Technical Seminar	CC	-	-	2	100	--	100	1
5	16CE4207	Comprehensive Viva Voce	CC	-	-	-	--	100	100	3
6	16CE4208	Major Project	CC	-	-	15	30	70	100	10
		Total		10	1	17	220	380	600	24
		Total Periods Per Week			28					

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Comparison of AICTE Guidelines for Curriculum Structure for B.Tech Degree Program in Civil Engineering Vis-à-vis GCET Program

Sl. No	Broad Course Classification	Course Group/ Category	Course Description	Range of percentage credits given by AICTE	Credits Allotted in Civil Engineering Program	
					Number	%
1	Foundation Courses (FnC)	HS - Humanities and Social Sciences	Includes courses related to Humanities, Social Sciences and Management.	5% - 10%	14	7.3
2		BS - Basic Sciences	Includes courses related to Mathematics, Physics, Chemistry and Biology.	15% - 20%	29	15.1
3		ES - Engineering Sciences	Includes courses related to Materials, Workshop, Drawing, Basics of Electrical/ Electronics/ Mechanical/ Computer Engineering, Instrumentation.	15% - 20%	24	12.5
4	Core Courses (CoC)	PC - Professional Core	Includes core courses related to the chosen Parent Discipline/ Department/ Specialization/ Branch of Engineering.	30% - 40%	78	40.6
5	Elective Courses (ElC)	PE - Professional Electives	Includes Elective subjects related to the Parent Discipline/ Department/ Specialization/ Branch of Engineering.	10% - 15%	19	9.9
		SC - Soft Core	Includes core elective courses of the parent discipline with the associated laboratory			
6		OE - Open Electives	Include inter-disciplinary elective courses in an area outside the Parent Discipline/ Department/ Specialization/ Branch of Engineering.	5% - 10%	12	6.3
7	Core Courses (CC)	Industrial Training/ Mini Project	Industrial Training/ Internship/ UG Mini-project	10% - 15%	16	8.3
		Project Work	B.Tech Project or UG Project or UG Major Project			
		Technical Seminar	Seminar/ Colloquium based on core contents related to the Parent Discipline/ Department/ Specialization/ Branch of Engineering.			
Grand Total					192	100

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OPEN ELECTIVES offered by a Department SHOULD NOT be taken by the students of the same department

Open Elective I

S. No.	Course Title	Course Code
21	Intellectual Property Rights (MBA)	16MB3121/16MB3221
22	Industrial Safety and Hazards (EEE)	16EE3122/16EE3222
23	JAVA Programming (CSE)	16CS3123/16CS3223
24	Electronic Measuring Instruments (ECE)	16EC3124/16EC3224
25	Nano Materials and Technology (ME)	16ME3125/16ME3225
26	Global Warming and Climate Change (CE)	16CE3126/16CE3226

Open Elective II

S. No.	Course Title	Course Code
31	Supply Chain Management (MBA)	16MB3231/16MB4131
32	Knowledge Management (CSE)	16CS3232/16CS4132
33	Energy Conservation and Management (EEE)	16EE3233/16EE4133
34	Basics of Communication Systems(ECE)	16EC3234/16EC4134
35	Manufacturing Processes (ME)	16ME3235/16ME4135
36	Building Technology (CE)	16CE3236/16CE4136

Open Elective III

S. No.	Course Title	Course Code
41	Banking and Insurance (MBA)	16MB3241/16MB4141
42	Database Systems (CSE)	16CS3242/16CS4142
43	Micro-electro-mechanical Systems(EEE)	16EE3243/16EE4143
44	Principles of Wireless Communication Systems (ECE)	16EC3244/16EC4144
45	Aspects of Heat Transfer in Electronically Controlled Units(ME)	16ME3245/16ME4145
46	Green Buildings (CE)	16CE3246/16CE4146
47	Foreign Language – French	16EN3247/16EN4147
48	Foreign Language –Spanish	16EN3248/16EN4148
49	Foreign Language –German	16EN3249/16EN4149

Open Elective IV

S. No.	Course Title	Course Code
51	Entrepreneurship (MBA)	16MB4251
52	Web Development (CSE)	16CS4252
53	Renewable Energy Sources (EEE)	16EE4253
54	Biomedical Instrumentation (ECE)	16EC4254
55	Materials Handling (ME)	16ME4255
56	Disaster Mitigation and Management (CE)	16CE4256
57	Actuarial Statistics (S&H)	16MA4257

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16CE4101 – ESTIMATION, COSTING & CONTRACTS

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16CE2202 Concrete Technology
16CE3102 Design of Reinforced Concrete Structures
16CE3201 Design of Steel Structures

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Gain knowledge on the process of estimations required for various works in construction.
2. Understand the rate analysis for various items of work and to prepare an abstract estimate.
3. Prepare a contract document.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain various estimation methods and standard principles.
CO 2: Identify units for various quantities of items of work
CO 3: Perform detailed estimation of buildings.
CO 4: Prepare earthwork quantity for roads and canals.
CO 5: Analyze rates for various items of work.
CO 6: Prepare a specification report and valuate a building construction.
CO 7: Explain the various types of contracts.

UNIT – I
General items of work in Building – Standard Units Principles of working out quantities for detailed and abstract estimates – Approximate method of Estimating.

UNIT – II
Detailed Estimates of Buildings - Reinforcement bar bending and bar requirement schedules

UNIT – III
Earthwork for roads and canals.

UNIT – IV
Rate Analysis – Working out data for various items of work over head and contingent charges.

UNIT-V
Contracts – Types of contracts – Contract Documents – Conditions of contract.
Valuation of buildings -Standard specifications for different items of building construction.

NOTE: NUMBER OF EXERCISES PROPOSED:
1. Three in flat Roof & one in Sloped Roof
2. Exercises on Data – Three Nos.

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Text Books:
1. Estimating and Costing, B.N. Dutta, UBS publishers, 2016.

Reference Books:
1. Estimating and Costing, G.S. Birdie, Dhanpat Rai Publishers, 2014.
2. Standard Schedule of rates and standard data book, Public works department.
3. I. S. 1200 (Parts I to XXV – 1974/ method of measurement of building and Civil Engineering works – B.I.S.)
4. Estimation, Costing and Specifications, M. Chakraborthi, Laxmi publications, 2006.

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16CE4102–ADVANCED STRUCTURAL ANALYSIS
PROFESSIONAL ELECTIVE - I

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16CE3101–STRUCTURAL ANALYSIS

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand KANI'S method, concept of analyzing cables and suspension bridges.
2. Understand matrix methods of analysis –stiffness method and flexibility method.
3. Understand plastic analysis of beams and portal frames.
4. Study multi-storey frames subjected to lateral loads
5. Understand methods of analysis of intermediate trusses for the external loads and influence line concept for indeterminate structures.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain analysis of single bay single storey and two storey structure using KANI'S method, able to draw SFD and BMD for the frames.
CO 2: Apply the method of analyzing suspension cables subjected to different loads.
CO 3: Able to understand about the static and kinematic indeterminacies, also able to analyze continuous beams, pin jointed frames using stiffness and flexibility method.
CO 4: Explain the plastic analysis & its mechanism for beams and frames.
CO 5: Analysis of multi storey frames for lateral loads by different methods like cantilever method, portal frame method etc.
CO 6: Able to draw ILD for indeterminate beams & analysis of trusses for single and two degree indeterminacy.

UNIT – I
Kani's Method: Analysis of single bay single storey frames by Kani's Method (Sway & Non-sway). Shear force diagram, bending moment diagram and elastic curves.
Cables and Suspension Bridges: Equilibrium of a Suspension Cable subjected to concentrated loads and uniformly distributed loads. Length of Cable. Suspension cable supports. Suspension Bridges. Analysis of Three Hinged Stiffening Girder, Suspension Bridges.

UNIT - II
Matrix Methods of Analysis: Introduction – Static and Kinematic Indeterminacy - Analysis of continuous beams including settlement of supports, using stiffness method. Analysis of pin-jointed plane frames using stiffness method- Analysis of single bay single storey frames including side sway, using stiffness method. Analysis of continuous beams upto three degree of indeterminacy using flexibility method. Shear force and bending moment diagrams.

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UNIT – III
Plastic Analysis: Ductility-ultimate load-plastic Hanger-shape factor- Moment curvature Relation –upper and lower band theory. – Plastic Analysis beam-portal frames-mechanism-portal survey Mechanism.

UNIT – IV
Approximate Methods of Analysis: Introduction – Analysis of multi-storey frames for lateral loads: Portal Method, Cantilever method and Factor method.

UNIT – V
Influence Lines for Indeterminate Beams: Introduction – ILD for two span continuous beams with constant and variable moments of inertia. ILD for propped cantilever beams. Muller Breslau's principle.

Indeterminate Trusses: Determination of static and kinematic indeterminacies – Analysis of trusses having single and two degrees of internal and external indeterminacies- Castigliano's second theorem

Text Books:
 1. Analysis of Structures - Vol –I & II, V.N.Vazirani, M.M.Ratwani and Dr. S.K Duggal, Khanna Publishers, 2016.
 2. Advanced Structural Analysis, A.K.Jain, Nem Chand Bros, 2015.
 3. Theory of Structures Vol I & II, G.S.Pandit, S.P.Gupta and R Gupta, McGraw Hill Education, 2017.

References Books:
1. Structural Analysis Vol-I & II, R. Vaidyanathan, P. Perumal, Laxmi Publications, 2016.
2. Matrix Analysis of Structures, Singh, Cengage Learning Pvt. Ltd, 2013.
3. Structural Analysis, R.C.Hibbeler, Pearson Education, 2008.
4. Structural Analysis SI edition, Aslam Kassimali, Cengage Learning, 2011.

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16CE4103 - AIR AND WATER TRANSPORTATION
PROFESSIONAL ELECTIVE - I

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16CE3104 Transportation Engineering.

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Enable the students to know the Air craft performance characteristics.
2. Understand design principles of Airport.
3. Understand various aspects of Water Transportation Systems i.e. Ports and Harbours.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Fix the orientation of the runways.
CO 2: Carryout geometrical design of the airport infrastructure.
CO 3: Prepare structural designs of runway, taxiway, and apron-grate area.
CO 4: Prepare a plan of the airport terminal area.
CO 5: Prepare a plan of the sea port.
CO 6: Provide solution to protect coastal erosion.

UNIT-I
Air Transportation: Aircraft Characteristics - Landing gear configurations, aircraft weight, engine types, Aircraft performance characteristics: speed, payload and range, runway performance, declared distances, wingtip vortices.

UNIT-II
Geometric Design of the Airfield **-** Airport classification: utility airports, transport airports, Runways: runway configurations, runway orientation, wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, Taxiways and taxi lanes: widths and slopes, taxiway and taxi lane separation requirements, sight distance and longitudinal profile, location of exit taxiways, design of taxiway curves and intersections, end-around taxiways, Aprons: holding aprons, terminal aprons and ramps, surface gradients, Control tower visibility requirements.

UNIT-III
Structural Design of Airport Pavements **-** Soil investigation and evaluation: CBR, plate bearing test, Young's modulus, FAA pavement design methods: equivalent aircraft, cumulative damage failure, Design of flexible and rigid airport pavements.

UNIT-IV
Airport Lighting, Marking, and Signage **-** Requirements of visual aids, approach lighting system configurations, visual approach slope aids, threshold lighting, Runway and taxiway lighting and marking, airfield signage.

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Terminal Area **-** Passenger terminal system and its components, Apron gate system: number of gates, gate size, aircraft parking type, apron layout, apron circulation, passenger conveyance to aircraft.

UNIT-V

Water Transportation: Ports and Harbours **-** Types of water transportation, water transportation in India, Ports and harbours: requirements, classification, ship characteristics, Harbour works: breakwaters, jetties, fenders, piers, wharves, dolphins, etc., Navigational aids: types, requirements, light house, beacon lights, buoys, Port facilities: general layout, development, planning, facilities, terminals.

Docks, Dredging, Coastal Erosion and Protection - Docks and repair facilities: design, dry docks, wet docks, slipways, Locks and lock gates: materials, size, Dredging: classification, dredgers, uses of dredged materials, Coastal erosion and protection: seal wall, revetment, and bulkhead.

Text Books:

1. Airport Planning and Design, S.K. Khanna, M.G. Arora, S.S. Jain, Nem Chand and Bros Publishers, 2012.
2. A Course in Docks and Harbour Engineering, S.P. Bindra, Dhanpat Rai Publications, 2012.

Reference Books:

1. Airport Systems: Planning, Design and Management, Dr. Richard de Neufville, A.R. Odoni, McGraw-Hill Publishers, 2013.
2. Harbour, Dock and Tunnel Engineering, R. Srinivasan, Charotar Publishing House, 2016.
3. Airport Engineering: Planning, Design and Development of 21st Century Airports, N. J. Ashford, S.A. Mumayiz, and P.H. Wright, John Wiley & Sons, 2012.
4. Planning and Design of Airports, R. Horonjeff, F.X. McKelvey, W.J. Sproule, and S.B.Young, McGraw-Hill Publishers, 2010.

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16CE4104 – GROUND IMPROVEMENT TECHNIQUES
PROFESSIONAL ELECTIVE - I

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16CE3105 Geotechnical Engineering

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand the importance of ground improvement
2. Understand various ground improvement techniques involved in improving the bearing capacity of soil.
3. Gain knowledge on grouting.
4. Understand the concepts of compaction.
5. Gain knowledge on soil reinforcement.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Identify suitable ground improvement technique for any given site condition.
CO 2: Explain in detail the different grouting methods.
CO 3: Explain soil stabilization method.
CO 4: Explain soil reinforcement by using geosynthetic materials.
CO 5: Explain the importance of soil compaction.

UNIT I
Introduction to Engineering Ground Modification: Need and objectives, Identification of soil types, In situ and laboratory tests to characterise problematic soils; Mechanical, Hydraulic, Physico-chemical, Electrical, Thermal methods, etc. and their applications.

UNIT II
Mechanical Modification – Principles of soil densification – Properties of Compacted soil, Compaction control tests, Specification of compaction requirements, Blasting Vibro compaction, Dynamic Tamping and Compaction piles.
Stabilisation - Method of stabilisation –Mechanical stabilisation, cement , lime , bituminous and Chemical stabilisation

UNIT III
Hydraulic Modification – Objectives and techniques, traditional dewatering methods and their choice, Design of dewatering system, Electro-osmosis, Filtration, Drainage and seepage control with Geosynthetics, types of Geosynthetic, Preloading and vertical drains, Electro-kinetic dewatering.

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UNIT IV

Physical and Chemical Modification – Modification by admixtures, Shotcreting and Guniting Technology, Modification at depth by grouting, Crack Grouting and compaction grouting, Jet grouting, Thermal Modification, Ground freezing.

UNIT V

Modification by Inclusions and Confinement - Soil reinforcement, reinforcement with strip, bar, mesh, sheet and grid reinforced soil. In-situ ground reinforcement, ground anchors, rock bolting and soil nailing.

Text Books:

1. Engineering Principles of Ground Modification, Manfred R. Hausmann, McGraw Hill Education, 2013.
2. Ground Improvement Techniques, Dr. P. Purushothama Raj, Laxmi Publications, 2016.

Reference Books:

1. Engineering Treatment of Soils, F.G. Bell, CRC Press, 2006.
2. Ground Improvement Techniques, Nihar Ranjan Patra, Vikas publishing house, 2012.
3. Earth Reinforcement and Soil Structures, Colin JFP Jones, Butterworth-Heinemann Publishers, 2013.
4. Ground Improvement, M.P.Moseley and K.Kirsch, CRC Press, 2004.
5. Ground Improvement, Klaus Kirsch & Fabian Kirsch, CRC Press, 2010.
6. Soil Improvement and Ground Modification Methods, Peter G. Nicholson, Butterworth-Heinemann Publishers, 2014.

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16CE4105 – **HYDROPOWER ENGINEERING**
PROFESSIONAL ELECTIVE - I

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16CE3103 – Engineering Hydrology.
16CE3204 – Irrigation Engineering.

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Acquire the knowledge of preparing flow duration curves and power duration curves.
2. Understand performance factors of hydro turbines.
3. Comprehend the hydraulics of turbines, cavitation problems and remedies.
4. Understand the design principles of penstocks.
5. Evaluate the need for gates and surge tanks.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Analyse stream flow and prepare hydrographs.
CO 2: Estimate hydropower potential.
CO 3: Determine electrical load on hydro turbines.
CO 4: Identify types of hydropower plants.
CO 5: Design penstocks and surge shaft.
CO 6: Plan the layout of a hydropower plant and carry out its structural design.

UNIT–I
Stream flow analysis, Hydrograph, Mass curve, Runoff estimation methods, Estimation of hydropower potential, flow duration curves, power duration curves, pondage and storage.

UNIT–II
Electrical load on hydro turbines, load curves, load duration curves, Performance factors.

UNIT–III
Types of hydropower plants, Storage power plant, Runoff River plant, Pumped storage plant, two units and three unit arrangements, Reversible pump turbines, types of turbines, hydraulics of turbines, cavitation in turbines, efficiency of pumped storage plants.

UNIT–IV
Intakes, losses in intakes, air entrainment at intake, inlet aeration, Water conveyance systems, fore bay, canals, Tunnels and Penstocks, classification of penstocks, design criteria of penstock, economical diameter of penstock, Anchor blocks, Conduit valves, type of valves, bends and manifolds.

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UNIT–V
Water hammer, resonance in penstocks, channel surges, Gates, Surge tanks, Power house layout, lighting and ventilation, variations in design of power house, underground power house, structural design of power house.

Text Books:
1. Irrigation, Water Power & Water Resources Engineering, Dr. K.R. Arora, Standard Publishers, 2014.
2. Water Power Engineering, M.M. Dandekar and K.N. Sharma, Vikas Publishers, 2016.

Reference Books:
1. A Text book of Water Power Engineering, R.K. Sharma and T.K. Sharma, S.Chand & Company, 2008.
2. Irrigation Engineering and Hydraulic Structures, S.K. Garg, Khanna Publishers, 2014.
3. Hydro-electric and Pumped Storage Plants, M.G. Jog, New Age International Publishers, 2009.

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16CE4106–PRESTRESSED CONCRETE AND PRECAST STRUCTURES
PROFESSIONAL ELECTIVE - II

IV Year. B.Tech. CE– I Semester.
Prerequisite(s): 16CE3102 Design of Reinforced Concrete Structures

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Impart knowledge of Prestressed concrete, its advantages and disadvantages.
2. Understand pre and post tensioning of simple structures & their systems.
3. Understand analysis of flexure and shear.
4. Understand losses of prestress in pretensioned & post tensioned members.
5. Understand composite beams & deflections.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain the principle of prestressing, pretensioning & post tensioning, its limitations & characteristics also the different methods and system of prestressing.
CO 2: Explain about the losses of prestress in pretensioned & post tensioned members.
CO 3: Analyse the sections for flexural and shear can be known.
CO 4: Describe transfer of prestress in pretensioned and posttensioned members, BIS Provision.
CO 5: Explain composite beams, like propped and unpropped members, deflection - short term & long term deflections.

UNIT-I:

Introduction: Historic development- General principles of prestressing pretensioning and post tensioning- Advantages and limitations of Prestressed concrete- General principles of PSC- Classification and types of prestressing- Materials- high strength concrete and high tensile steel their characteristics.

UNIT-II:

Methods and Systems of prestressing: Pretensioning and Posttensioning methods and systems of prestressing like Hoyer system, Magnel Blaton system, Freyssinet system and Gifford- Udall System- Lee McCall system.

Losses of Prestress: Loss of prestress in pretensioned and posttesnioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional losses IS 1343-2012 code provisions

UNIT-III:
Flexure: Analysis of sections for flexure- beams prestressed with straight, concentric, eccentric, bent and parabolic tendons- stress diagrams- Elastic design of PSC slabs and beams of rectangular and I sections- Kern line – Cable profile and cable layout.

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Shear: General Considerations- Principal tension and compression- Improving shear resistance of concrete by horizontal and vertical prestressing and by using inclined or parabolic cables- Analysis of rectangular and I beams for shear – Design of shear reinforcements- IS Code provisions**.**

UNIT-IV:
Transfer of Prestress in Pretensioned Members : Transmission of prestressing force by bond – Transmission length – Flexural bond stresses – IS code provisions – Anchorage zone stresses in post tensioned members – stress   distribution in End   block – Analysis by Guyon, Magnel, Zienlinski and Rowe's methods – Anchorage zone reinforcement- IS 1343-2012 code Provisions

UNIT-V
Composite Beams: Different Types- Propped and Unpropped- stress distribution- Differential shrinkage- Analysis of composite beams- General design considerations.

Deflections: Importance of control of deflections- Factors influencing deflections – Short term deflections of uncracked beams- prediction of long term deflections- IS code requirements.

Text Books:
1. Prestressed concrete, N. Krishna Raju, McGraw Hill Education, 2012.
2. Precast Concrete Structures, Hubert Bachmann and Alfred Steinle, Wiley India Pvt. Ltd., 2018.

Reference Books:
1. Prestressed Concrete, N. Rajagopalan, Narosa Publishing House, 2014
2. Design of Prestressed Concrete Structures, T.Y. Lin and Ned H. Burns, Wiley India Pvt Ltd, 2010.
3. Precast Concrete Structures, Kim S. Elliott, CRC Press, Second Edition, 2016.
4. Prestressed concrete, S. Ramamrutham, Dhanpat Rai Publishing company, 2016.

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16CE4107–HEALTH MONITORING AND RETROFITTING OF STRUCTURES
PROFESSIONAL ELECTIVE - II

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16CE3102 Design of Reinforced Concrete Structures

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand the concepts of distress in structures, types of damages and repairs.
2. Understand corrosion of steel reinforcement & its causes.
3. Understand inspection & testing.
4. Understand maintenance and repair strategies required for concrete.
5. Understand health monitoring of structures.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain the deterioration of structures, damage occurrence and mechanism of damages.
CO 2: Assess strength and materials deficiency in concrete structures, corrosion of steel reinforcement causes and prevention.
CO 3: Suggest techniques used in repairing /strengthening the existing concrete structures.
CO 4: Know the inspection and testing, non-destructive testing (NDT)
CO 5: Apply effective retrofitting strategies for the health monitoring of structures.

UNIT – I
Introduction – Deterioration of Structures – Distress in Structures – Causes and Prevention. Mechanism of Damage – Types of Damage

UNIT – II
Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation.

UNIT – III
Inspection and Testing – Symptoms and Diagnosis of Distress – Damage assessment – NDT.

UNIT – IV
Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shortcrete – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

UNIT – V
Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

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Text Books:
1. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications, 2009.
2. Non-Destructive Evaluation of Concrete Structures, J.M. Bungey, Surrey University.
3. Diagnosis and treatment of structures in distress, R.N. Raikar, 1994.

Reference Books:
1. Maintenance, Repair and Rehabilitation and Minor works of buildings, P.C. Varghese, PHI Learning, 2014.
2. Monitoring and Assessment of Structures, Graham Armer, CRC Press, 2001.
3. Building Failures: Diagnosis and Avoidance, W.H. Ransom, Routledge.
4. Defects and Deterioration in Buildings, B.A. Richardson, EF & N Spon Press, London.
5. Concrete Repair and Maintenance Illustrated, W.H. Ranso, RS Means Company Inc, 1991.
6. Building Failures: Diagnosis and Avoidance, B.A. Richardson, EF & N Spon Press, 1991.
7. Concrete Technology by A.R. Santakumar, Oxford University press, 2006.

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16CE4108–SOLID WASTE MANAGEMENT
PROFESSIONAL ELECTIVE - II

IV Year. B.Tech. CE– I Semester.
Prerequisite(s): None.

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand sources of solid waste generation, contamination and its impact on environment.
2. Understand different solid waste processing technologies.
3. Understand physical, chemical and thermal treatment of hazardous waste.
4. Understand the concepts of radioactive wastes and its management.
5. Understand recycling of e-waste.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Identify the physical and chemical composition of wastes.
CO 2: Analyse the functional elements for solid waste management.
CO 3: Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes.
CO 4: Identify and design waste containment systems.
CO 5: Design landfill systems and understand its operation and maintenance aspects.
CO 6: Management of biomedical waste.
CO 7: Explain e-waste characteristics and its regulations.

UNIT–I
Solid Waste and their Handling: Definition of Solid wastes – Types of solid wastes – Sources – Industrial, mining, agricultural and domestic – Characteristics. Solid waste problems – Impact on environmental health.

UNIT–II
Collection, Segregation, Transport and Management of Municipal Solid Wastes: Handling and segregation, Collection and storage of municipal solid wastes; analysis of collection systems. Transfer stations – labelling and handling of hazardous wastes. Solid waste processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery: Composting – Types, vermicomposting, termigradation, fermentation. Incineration of solid wastes. Disposal in landfills: site selection, design, and operation of sanitary landfills; Leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation. Regulatory aspects of municipal solid waste management.

UNIT–III
Hazardous Waste and its Management: Hazardous waste definition. Physical and biological routes of transport of hazardous substances – sources and characterization. Sampling and analysis of hazardous wastes – proximate analysis – Survey analysis – directed analysis. Handling, collection, storage and transport. Hazardous waste treatment technologies TSDF concept – Physical, chemical and thermal treatment of hazardous waste: solidification, chemical fixation, encapsulation, pyrolysis

and incineration. Hazardous waste land fills – Site selections, design and operation. HW reduction, recycling and reuse, Regulatory aspects of HWM/ HWM rules.

UNIT–IV
Biomedical Waste Management: Classification, collection, segregation treatment and disposal. Radioactive waste: Definition, Low level and high level radioactive wastes and their management, Radiation standards.
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UNIT–V
E-Waste Management: Waste characteristics, generation, collection, transport and disposal, regulatory aspects of e-waste, global strategy, recycling.

Text Books:
1. Integrated Solid Waste Management, George Tchobanoglous, Hilary Theisen and Samuel A. Vigil, McGraw Hill Education, 2014.
2. Hazardous Waste Management, Charles A. Wentz, McGraw Hill Education, 2000.

Reference Books:
1. Criteria for Hazardous waste landfills, CPCB guideline, 2000.
2. Standard Handbook of Hazardous Waste Treatment and Disposal, Harry M. Freeman, McGraw Hill Education, 1997.
3. Management of Solid waste in developing countries, Frank Flintoff, WHO regional publications.
4. Solid Waste Engineering, William A. Worrell, P. Aarne Vesilind, Cengage Learning, 2010.
5. Central Pollution Control Board (CPCB) guidelines: http://cpcb.nic.in/

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16CE4109 - GROUNDWATER DEVELOPMENT AND MANAGEMENT
PROFESSIONAL ELECTIVE - II

IV Year. B.Tech. CE– I Semester.
Pre Requisites:
16CE3103 Engineering Hydrology

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Enable the students to know about groundwater occurrence.
2. Grasp the knowledge of various theories and methods of knowing the groundwater levels.
3. Understand the methods of artificial recharge of groundwater.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Determine the availability of Groundwater, its movement and its contour applications.
CO 2: Estimate yield of aquifers.
CO 3: Explain the methods of artificial recharge of groundwater.
CO 4: Explain Groundwater movement and Well construction.

UNIT – I
Groundwater Occurrence: Groundwater hydrologic cycle, origin of groundwater, rock properties effecting groundwater, vertical distribution of groundwater, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention.

UNIT – II
Groundwater Movement: Permeability, Darcy's law, storage coefficient. Transmissivity, differential equation governing groundwater flow in three dimensions derivation, groundwater flow equation in polar coordinate system. Groundwater flow contours their applications.

UNIT – III
Steady groundwater flow towards a well in confined and unconfined aquifers – Dupuit's and Theim's equations, Assumptions, Formation constants, yield of an open well interface and well tests – Recuperation Test.
Unsteady flow towards a well – Non equilibrium equations – Theis' solution – Jacob and Chow's simplifications, Leaky aquifers – Well Interference.

UNIT – IV
Surface and Subsurface Investigation: Surface methods of exploration – Electrical resistivity and Seismic refraction methods. Subsurface methods – Geophysical logging and resistivity logging. Aerial Photogrammetry applications along with Case Studies in Subsurface Investigation.

Artificial Recharge of Groundwater: Concept of artificial recharge – recharge methods, relative merits, Applications of GIS and Remote Sensing in Artificial Recharge of Groundwater along with Case studies.

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UNIT – V
Well Construction – Drilling Equipment used for Well Construction – Bore log – Interpretation of Log Data.

Saline Water Intrusion in aquifer: Occurrence of saline water intrusions, Ghyben- Herzberg relation, Shape of interface, control of seawater intrusion. Groundwater Basin Management: Concepts of conjunction use, Case studies.

Text Books:
1. Groundwater Hydrology, David K. Todd, Larry W. Mays, Wiley India Pvt Ltd, 2015.
2. Groundwater, H.M.Raghunath, New Age International, 2015.

Reference Books:
1. Groundwater Hydrology, Bhagu R. Chahar, McGraw Hill Education, 2017.
2. Groundwater Hydrology, Herman Bouwer, John Wiley & sons.
3. Elements of Hydrology and Groundwater, R.N.Saxena and D.C.Gupta, PHI learning, 2017.
4. Groundwater Systems: Planning & Management, Robert Willis, William W-G Yeh, Prentice Hall Publishers.
5. Applied Hydrogeology, C.W.Fetter, Pearson, 2000.

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16MB4131-SUPPLY CHAIN MANAGEMENT
(Open Elective-II)

IV Year. B.Tech. CE – I SEMESTER
Pre requisites: None

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Distinguish the different functional areas in businesses management; understand the cross functional integrations and map supply chains of various business sectors.
2. Identify different types of distribution/ modes of transport/ network design.
3. Analyze the operational issues in SCM.
4. Recognize the drivers of supply chain.
5. Interpret the importance of relationships with suppliers and customers.

Course Outcomes(COs):
At the end of the course, student would be able to:
CO1   Understand the role of an Engineer as well as Manager in Supply chain management
CO2   Appreciate the importance of logistics in integrating different functional areas.
CO3   Integrate operations with functional areas.
CO4   Visualize the role of logistics and distribution as supply chain drivers
CO5   Understand the importance of supplier and customer relationship management.

UNIT - I:
Introduction to Supply Chain Management
Understanding the Supply Chain, Supply Chain Performance: Achieving Strategic Fit and Scope including: Customer and Supply Chain Uncertainty, Competitive and Supply Chain Strategies, Product development strategy, Marketing and sales strategy, Supply chain strategy, Scope of strategic fit; Supply Chain Drivers and Metrics.

UNIT - II:
Logistics Management
Designing distribution networks and applications to e-Business, Network design in the Supply Chain, Designing global supply chain, network design, 3 PL, 4 PL, Transportation in supply chain management.

UNIT - III:
Planning and managing inventories
Managing Economies of Scale in a Supply Chain: Cycle Inventory, Managing Uncertainty in a Supply Chain: Safety Inventory, Determining the Optimal Level of Product Availability. Demand Forecasting in a Supply Chain, Aggregate Planning in a Supply Chain, Sales and Operations Planning: Planning Supply and Demand in a Supply Chain, Coordination in a Supply Chain. E-Procurement, Global alliances.

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UNIT - IV:
Managing Cross-Functional Drivers in a Supply Chain
Importance of sourcing decisions in Supply Chain Management, Price and Revenue management, role of Information Technology in a Supply Chain, Sustainability and the Supply Chain. Customer Relationship management.

UNIT - V:
Logistics and supply chain relationships
Identifying logistics performance indicators- channel structure- economics of distribution- channel relationships- logistics service alliance. Managing global logistics and global supply chains: Logistics in a global economy- Views of global logistics- global operating levels interlinked global economy. Global supply chain, Supply chain management in Global environment Global strategy- Global purchasing- Global logistics- Global alliances- Issues and Challenges in global supply chain management.

Text Books:
  1 Sunil Chopra, Peter Meindle, D.V Kalra, Supply Chain Management 6/e, Pearson.
  2 Donald J. Bowersox and David J. Closs, Logistics Management: The Integrated Supply Chain Process, TMH, 2006.
  3 Sridhara Bhatt, "Logistics and Supply Chain Management", EXCEL, 2009

Reference Books:
  1. The Toyota Way Paperback by Jeffrey Liker.

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16CS4132 - KNOWLEDGE MANAGEMENT
(Open Elective - II)

IV Year. B. Tech. CE- I Semester

L	T	P/D	C
3	-	-/-	3

Pre requisites: None

Course Objectives:
Develop ability to:
1. Understand Knowledge Management systems for access and coordination of knowledge assets.
2. Understand technologies namely, intranets, groupware, weblogs, instant messaging, content management systems and email in both individual and organizational contexts.
3. Use case studies, research methods of knowledge organization.

Course Outcomes:
At the end of the course, the student would be able to:
CO1. Evaluate and implement Knowledge Management Systems to facilitate individual and group work.
CO2. Develop a thorough review of Knowledge Management concepts, both historical and speculative.
CO3. Originate and distribute research on a Knowledge Management System topic.
CO4. Analyze and design KM processes and systems.

UNIT - I
Knowledge Management
KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – Expert Knowledge – Human Thinking and Learning.

UNIT - II
Knowledge Management System Life Cycle
Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture.

UNIT - III
Capturing Knowledge
Evaluating the Expert – Developing a Relationship with Experts – Fuzzy Reasoning and the Quality of Knowledge – Knowledge Capturing Techniques, Brain Storming – Protocol Analysis – Consensus Decision Making – Repertory Grid- Concept Mapping – Black boarding.

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UNIT – IV
Knowledge Codification
Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developer's Skill Sets – System Testing and Deployment – Knowledge Testing – Approaches to Logical Testing, User Acceptance Testing – KM System Deployment Issues – User Training – Post implementation.

UNIT - V
Knowledge Transfer And Sharing
Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.

Text Book(s):
1. Elias.M. Award & Hassan M. Ghaziri – "Knowledge Management" Pearson Education.

Reference Books:
1. Guus Schreiber, Hans Akkermans, AnjoAnjewierden, Robert de Hoog, Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering and Management", Universities Press, 2001.
2. C.W. Holsapple, "Handbooks on Knowledge Management", International Handbooks on Information Systems, Vol 1 and 2, 2003

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16EE4133–ENERGY CONSERVATION AND MANAGEMENT
(Open Elective - II)

IV Year. B.Tech. CE – I Semester

L	T	P/D	C
3	-	-/-	3

Prerequisite: None

Course Objectives:
Develop ability to:
1. Understand different basic terms related to Indian Energy Scenario and Energy Conservation Act.
2. Understand the principles of energy conservation, audit and management.
3. Understand energy conservation in different mechanical utilities.
4. Understand efficient heat and electricity utilization, saving and recovery in different thermal and electrical systems.
5. Understand different basic terms related to Energy economy, Financial Management and to understand the role of Energy Service Companies.

Course Outcomes:
At the end of the course, student would be able to:
  CO1. Perform energy accounting and balancing
  CO2. Prepare energy audit report for different energy conservation instances.
  CO3. Suggest energy saving methodologies.
  CO4. Evaluate the energy saving and conservation in different mechanical utilities.
  CO5. Evaluate the energy saving and conservation in different electrical utilities.

UNIT-I
Energy Scenario, Conservation Act and related policies
Classification of Energy, Indian energy scenario, Sectorial energy consumption(domestic, and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future. Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction.

UNIT-II
Energy Management and Audit
Principles of Energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy management qualities and functions, language Questionnaire – check list for top management. Definition, energy audit, need, types of energy audit. Energy management (audit) approach – understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering.

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UNIT-III
Energy Efficient Systems-I
Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp–voltage variation – voltage unbalance – over motoring – motor energy audit.

Power Factor Improvement, Lighting and Energy Instruments
Power factor – methods of improvement, location of capacitors, power factor with non-linear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – energy instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

UNIT-IV
Energy Efficient Systems-II
Thermal utilities and systems: Boilers – types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas, soot blowing and soot deposit reduction.

Heat Exchangers: Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc.,

Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential

Cogeneration: Definition, need, application, advantages, classification, saving potentials, heat balance, steam turbine efficiency, tri-generation, micro turbine.

UNIT-V
Energy Economics
Discount rate, payback period, internal rate of return, net present value, life cycle costing, role of energy service companies (ESCOs), investment – need, appraisal and criteria, financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts.

Text Books:
1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

Reference Books:
1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

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3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982.
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.
6. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
7. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press
8. Bureau of Energy Efficiency Reference book: No.1, 2, 3 4
9. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Inter-science publication
10. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by E J Wilson and D Gerard, Blackwell Publishing
11. Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994.

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16EC4134 – BASICS OF COMMUNICATION SYSTEMS
(Open Elective - II)

IV Year. B.Tech. CE – I Semester

L	T	P/D	C
3	-	-/-	3

Pre-requisites: None
Note: Only Block Diagram Approach with Qualitative Treatment of the topics is required.
Detailed mathematical treatment is <u>not</u> required.

Course Objectives:
    1. Introduce the students to modulation and various analog and digital modulation schemes.
    2. They can have a broad understanding of satellite, optical, cellular, mobile, wireless and telecom concepts.

Course Outcomes:
After completion of this course, the students would be able to:
    CO1. Distinguish various types of modulations.
    CO2. Explain different communication modules and their implementation.
    CO3. Distinguish various wireless and cellular, mobile and telephone communication systems.

Unit I:
Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

Unit II:
Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, AM Radio, FM Radio, Transmitters and Receivers

Unit III:
Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony,

Networking and Local Area Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

Unit IV:
Satellite Communication: Satellite Orbits, Satellite communication systems, Satellite subsystems, Ground Stations, Satellite Applications, Global Positioning systems.

Optical Communication: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

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Unit V: Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, WCDMA.

Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

Text Books:
1. "Principles of Electronic Communication Systems", Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. "Electronic Communications systems", Kennedy, Davis, 4e, TMH, 1999.

Reference Books:
1. "Introduction to Telecommunications Network Engineering", Tarmo Anttalainen, Artech House Telecommunications Library.
2. "Wireless Communications-Principles and practice", Theodore Rappaport, Prentice Hall, 2002.
3. "Fundamentals of Telecommunications", Roger L. Freeman, 2e, Wiley publications.
4. "Introduction to data communications and networking", Wayne Tomasi, Pearson Education, 2005.

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16ME4135 – MANUFACTURING PROCESSES
(Open Elective - II)

IV Year. B.Tech. ECE – I Semester

L	T	P/D	C
3	-	-/-	3

Pre-requisites: None

Course Objectives:
1. Understand about sand casting and metal casting techniques.
2. Impart the knowledge of various welding processes.
3. Understand about the importance rolling, forging and sheet metal operations.
4. Understand about the processing of plastics.

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1.   Analyze and select the suitable casting technique for making the components.
CO2.   Differentiate the different types of welding processes are needed for various materials and importance of welding
CO3.   Recognize and adopt the methods involved in forming processes, sheet metal operations, rolling, forging etc.,
CO4.   Perform the methods involved in press work
CO5.   Know the various manufacturing methods in processing of plastics.

UNIT - I:
Casting : Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.
Methods of Melting - Crucible melting and cupola operation – Defects in castings;
Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

UNIT - II:
Welding: Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding. Inert Gas Welding _ TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

UNIT - III:
Forming: Hot working, cold working, strain hardening, recovery, recrystallization and grain growth.
Stamping, forming and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

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UNIT - IV:

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

UNIT - V:

Forging Processes: Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

Text Book(s):
1. Manufacturing Technology / P.N. Rao/TMH

Reference Books:
1. Production Technology / R.K. Jain
2. Metal Casting / T.V Ramana Rao / New Age
3. Principles of Metal Castings / Rosenthal.
4. Welding Process / Parmar /
5. Production Technology /Sarma P C /
6. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.

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16MB4141 – BANKING AND INSURANCE
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre-requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Learn the importance of banking business and its functions.
2. Understand the services in banking sector.
3. Examine the importance of RBI and its significance.
4. Understand the insurance sector.
5. Identify regulatory framework of insurance sector.

Course Outcomes (COs):
At the end of the course, student would be able to:
   CO1   Acquire the knowledge of banking system.
   CO2   Acknowledge banking services and types of banks.
   CO3   Absorb regulation pattern on banking sector.
   CO4   Identify the need of insurance sector and its significance.
   CO5   Acknowledge IRDA and other insurance patterns in India.

UNIT-I:
Introduction to banking business: Concept and history of banking system in India, banking structure – types of accounts, advances and deposit system in India-cheque process and clearing system.

UNIT-II:
Card System and classification of banks: Types of cards and its importance (Debit, credit, smart-card) net banking, mobile banking , KYC system, Nationalization of banks- commercial, private, public and foreign banks- regional rural banks and local bankers- money lenders and pawn brokers.

UNIT-III:
Reserve Bank of India Act 1934: Establishment of RBI Act and Banking Regulation Act 1949-features-functions- Mint (coin printing) -money control, deficiencies in Indian banking system-problem and challenges, Non-Performing Assets (NPA's).

UNIT-IV:
Introduction to Insurance sector: Concept and nature of insurance- principles of insurance- new insurance products, bank assurance. Types of plans pricing and underwriting documentation. Channels of distribution- policy servicing and settlement of clients.

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UNIT-V:

Insurance Regulatory Development Authority 1999: History –features- importance of IRDA- general insurance Act 1972- feature and functions– LIC Act 1956, features and functions. Non life insurance and its kinds – difference between general insurance and life insurance.

Text Books:
1. Vijayragavan Iyengar, "Introduction to banking", Excel publications.
2. S.Arjunatesan and T.R. Vishwanthan, "Risk Management and Insurance", Macmillan.
3. Hals.Scott, "Capital Adequacy beyond Basel banking securities and insurance", Oxford

Reference Books:
1. Mishra, M.N, "Insurance principle and practice", Sultan Chand & Sons, New Delhi
2. VarshneyP.N., "Banking law and Practice", Sultan Chand & Sons, New Delhi
3. Reddy K S and Rao R.N, "Banking and Insurance", Paramount Publisher 2013.
4. George E.Rejda, "Principles of risk Management & Insurance", 9/e, Pearson Education.

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16CS4142 – DATABASE SYSTEMS
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives
Develop ability to:
1. Learn and practice data modeling using entity-relationship and develop database design.
2. Understand the features of database management systems and Relational database.
3. Understand Structured Query Language (SQL) and learn SQL syntax.
4. Understand normalization process of a logical data model and correct any anomalies.
5. Understand needs of database processing and learn techniques for controlling the consequences of concurrent data access.

Course Outcomes
After completion of the course, student would be able to:
CO1. Design and describe data models and schemas in DBMS.
CO2. Use SQL - the standard language of relational databases, for database processing.
CO3. Implement Transaction and Query processing techniques for data storage and retrieval.
CO4. Use backup and recovery techniques for handling the databases.
CO5. Use PL/SQL for database administration and performance optimization.

UNIT I
Introduction- Data base System Applications, Purpose of Database Systems, View of Data – Data Abstraction , Instances and Schemas , Data Models ,Introduction to Data base design , ER diagrams, Beyond ER Design, Entities, Attributes and Entity sets , Relationships and Relationship sets , Additional features of ER Model , Conceptual Design with the ER Model , Conceptual Design for Large enterprises, database Access for applications Programs ,Data Storage and Querying,– data base Users and Administrator ,data base System Structure ,History of Data base Systems. Database Languages – DDL, DML, DCL.

UNIT II
Relational Model: Introduction to the Relational Model - Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data, Logical data base Design, Introduction to Views – Destroying /altering Tables and Views.

UNIT III
Form of Basic SQL Query – Examples of Basic SQL Queries , Introduction to Nested Queries, Correlated Nested Queries Set – Comparison Operators – Aggregative Operators , NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs ,Outer Joins , Disallowing NULL values.

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UNIT IV
Transaction Management- Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability - Recoverability – Implementation of Isolation – Testing for serializability.

Concurrency Control - Lock –Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity.

Recovery system – Failure Classification- Storage Structure- Recovery – Atomicity – Log – Based Recovery- Recovery with Concurrent Transactions – Buffer Management – Failure with loss of non-volatile storage - Advance Recovery systems- Remote Backup systems.

UNIT V
PL/SQL and Database Administration
Fundamentals, Defining variables and data types, using SQL in PL/SQL, Program Structures to Control Execution Flow, Using Cursors and Parameters, Using Composite Data Types, Exception Handling, Using and Managing: Procedures, Functions, Packages and Triggers, Improving PL/SQL performance, Recognizing and Managing Dependencies, Using the PL/SQL Compiler.

Text Books:
1. Fundamentals of Database Systems, Elmasri, Navathe, 7th Edition, Pearson Education, 2016.
2. Oracle PL/SQL Programming, Steven Feuerstein, Bill Pribyl, O'Reilly, 5th Edition, 2009.

Reference Books:
1. Data base System Concepts, Silberschatz, Korth, McGraw hill, VI edition.
2. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
3. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
4. Introduction to Database Systems, C.J.Date Pearson Education

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16EE4143 – MICRO-ELECTRO-MECHANICAL SYSTEMS
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Understand semiconductors and solid mechanics used to fabricate MEMS devices.
2. Understand basics of Micro fabrication techniques.
3. Understand various sensors and actuators
4. Understand different materials used for MEMS
5. Understand applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:
At the end of the course, student would be able to:
CO1. Identify different types of semiconductor and solid mechanic materials that are used to fabricate MEMS devices.
CO2. Apply basic science, circuit theory, Electro-magnetic field theory, control theory in Micro fabrication techniques
CO3. Distinguish between different sensors and actuators
CO4. Distinguish between various processes involved in Micro machining
CO5. Apply the knowledge of MEMs to other advanced applications such as polymer and optical MEMs

UNIT-I
Basics: Intrinsic Characteristics of MEMS, Energy Domains and Transducers, Sensors and Actuators, Introduction to Micro fabrication, Silicon based MEMS processes, New Materials, Review of Electrical and Mechanical concepts in MEMS, Semiconductor devices, Stress and strain analysis, Flexural beam bending, Torsional deflection

UNIT-II
Sensors and Actuators-I: Electrostatic sensors, Parallel plate capacitors, Applications, Inter-digitated Finger capacitor, Comb drive devices, Micro Grippers, Micro Motors, Thermal Sensing and Actuation , Thermal expansion, Thermal couples, Thermal resistors, Thermal Bimorph, Applications, Magnetic Actuators, Micro-magnetic components, Actuation using Shape Memory Alloys

UNIT-III
Sensors and Actuators-II: Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements, Applications to Inertia, Pressure, Tactile and Flow sensors, Piezoelectric sensors and actuators, piezoelectric effects, piezoelectric materials, Applications to Inertia , Acoustic, Tactile and Flow sensors.

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UNIT –IV
Micromachining: Silicon Anisotropic Etching, Anisotrophic Wet Etching, Dry Etching of Silicon, Plasma Etching, Deep Reaction Ion Etching (DRIE), Isotropic Wet Etching, Gas Phase Etchants, Case studies, Basic surface micro machining processes, Structural and Sacrificial Materials, Acceleration of sacrificial Etch, Striction and Antistriction methods

UNIT –V
Polymer and Optical MEMS: Polymers in MEMS, Polimide, SU-8, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbon, Application to Acceleration, Pressure, Flow and Tactile sensors, Optical MEMS, Lenses and Mirrors, Actuators for Active Optical MEMS.

TEXT BOOKS:
1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCE BOOKS:
1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
4. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer 2012.

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16EC4144 – PRINCIPLES OF WIRELESS COMMUNICATION SYSTEMS
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Note: No detailed mathematical treatment is required.

Course Objectives:
1. To discuss the fundamentals of cellular mobile wireless networks.
2. To provide an overview of various approaches to communication networks.
3. To study the numerous different-generation technologies with their individual pros and cons.
4. To discuss about the principles of operation of the different access technologies like FDMA, TDMA, SDMA and CDMA and their pros and cons.

Course Outcomes:
After completion of this course, students would be able to:
CO1. Explain different generations of Cell phone technology
CO2. Explain different cellular, communication networks and different access techniques
CO3. Distinguish between different personal communication services
CO4. Explain the development of Wireless technologies beyond 2 G
CO5. Explain mobile data services and short range networks.

UNIT I - Transmission Fundamentals
Cell phone Generations: 1G, 2G, 2.5G, 3G & 4G
Transmission Fundamentals: Time domain & Frequency domain concepts, Radio, Analog Vs Digital, channel capacity, transmission media, carrier-based signaling, spread-spectrum signaling.

UNIT II - Network Concepts
Communication Networks: LANs, MANs, WANs, circuit switching, packet switching, ATM
Cellular Networks: Cells, duplexing, multiplexing, voice coding
Multiple Access Techniques: FDMA, TDMA, SDMA, CDMA, spectral efficiency.

UNIT III - Personal Communication Services
GSM, HSCSD, GPRS, D-AMPS, CDMA One, CDMA Two, Packet Data Systems.

UNIT IV - 3G and Beyond
IMT-2000, W-CDMA, CDMA 2000, EDGE, Wi-Fi, WiMAX, OFDM.

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UNIT V - Mobile Data Services & Short-Range Networks

Mobile Data Services: Messaging, wireless web, WAP, site design

Short-Range Wireless Networks: Unlicensed spectrum, WLANs, cordless telephony, IrDA, Bluetooth

Smart Phones: Future phones, mobile OSs, smart phone applications.

Text Books:

1. Andy Dornan, "The essential guide to wireless communications applications: from cellular systems to Wi-Fi", 2nd Edition, Prentice Hall, 2002.

2. Misra, "Wireless Communications and Networks: 3G & Beyond", Tata McGraw-Hill, 2009.

Reference Books:

1. Theodore S. Rappaport "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2009.

2. William Stallings, "Wireless communications and networking", Prentice Hall,2002.

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16ME4145 – ASPECTS OF HEAT TRANSFER IN ELECTRONICALLY CONTROLLED UNITS
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives:
1. To apply the Energy conservation principles to electronic devices.
2. To apply the conduction, convection and radiation principles to electronic devices.
3. To apply the Refrigeration and Air conditioning concepts to industrial applications.
4. To perform the heat dissipation analysis on electronic devices.

Course Outcomes:
At the end of the course, the student will be able to:
CO1. Analyse conduction, convection and radiation heat transfer modesin electronically controlled units.
CO2.Analyse heat generation in electronically controlled units.
CO3.Analyse conduction and dissipation in electronically controlled units.
CO4.Analyse the cooling load capacity in electronically controlled units.

UNIT-I: Conduction Heat transfer: Modes of heat transfer, Fourier's law of steady state heat conduction (one dimensional conduction), thermal conductivity and its unit, conduction through slab or plane wall, hollow cylinders and spheres conduction through composite walls and hollow cylinders and spheres with multi-layers, Convective heat transfer, Newton's law of cooling, electrical analogy and overall heat transfer coefficient, numerical problems

UNIT-II: Convective and radiation Heat transfer:
Dimensional analysis as a tool for experimental investigation, Buckingham pi theorem and method, radiation and radiation properties of surfaces, black body, emissive power, Stefan Boltzmann's law, emissivity, monochromatic emissive power and monochromatic emissivity, grey body, Kirchoff's law, Wien's displacement law, numerical problems.

UNIT – III: Cooling of Electronic equipment:
Introduction and history, manufacturing of electronic equipment, cooling load of electronic equipment, thermal environment, electronics cooling in different applications, conduction cooling, air cooling: natural convection and radiation, air cooling: forced convection, liquid cooling, immersion cooling, heat pipes, cooling of chips, PCBs, computers, logic chips etc.

UNIT – IV: Refrigeration and Air conditioning: Introduction to refrigeration, necessity and applications, unit of refrigeration and cop, Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

UNIT-V: Heat pipes: Structure – operation - construction - thermal resistance- performance characteristics - effects of working fluid and operating temperature, wick - selection of material - pore size, applications.

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Text books:
1. Heat Transfer- A practical approach by Yunus A. Cengel,Tata Mc Graw-Hill Edition
2. Heat Transfer – A conceptual approach – P.K.Sarma&K.Rama Krishna/New age
3. A course in Refrigeration and Air conditioning – SC Arora and &Domkundwar / Dhanpatrai

Reference books:
1. Fundamentals of Engineering, Heat and mass transfer – R.C. Sachdeva/New Age
2. Heat & mass Transfer – D.S.Kumar/S.K.Kataria & sons

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16EN4147 – FOREIGN LANGUAGE - FRENCH
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Recognize and pronounce French alphabet
2. Apply grammatical concepts in both oral and written communication.
3. Appreciate the culture of Francophone countries.
4. Read authentic texts.

Course Outcomes:
At the end of the course, student would be able to:
CO 1. Demonstrate competence in basic vocabulary and grammar
CO 2. Understand the culture of Francophone countries.
CO 3. Read with accurate pronunciation.
CO 4.Understand short and simple oral and written communication.

UNIT–I
Functional Aspects:
Greetings, introductions, asking/giving information, pronunciation and Spellings of Francophonic names, family relations, professions, days of the week and months, nationalities, languages, cardinal numbers and ordinal numbers, descriptions.

Grammatical Aspects:
Definite and Indefinite articles, numbers, adjectives, interrogation, negation, conjugation of the verbs in the present tense.

UNIT–II
Functional Aspects:
Intonation, vowels, orals and nasals, Inviting and responding to invitations, describing people.

Grammatical Aspects:
Past Tense- verbs used

UNIT–III
Functional Aspects:
Polite expressions-expressing opinions, making suggestions, expressing ideas and dislikes, agreeing and disagreeing.
Describing places, professions, dress and monuments of Paris and other public places.

Grammatical Aspects:
Regular and irregular verbs, conjugations, writing simple sentences using the verbs in present and past tense.

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UNIT–IV
Functional Aspects:
Semi-vowels, consonant sounds, Invitations, accepting and refusing invitations, fixing appointments, Inviting through telephone and e-mail.

Grammatical Aspects:
Partitif articles, adjectives, demonstrative and possessive, prepositions and adverbs of quantity and quality.

UNIT–V
Functional Aspects:
Asking for information in a restaurant, Ordering food in a restaurant, appreciating, describing leisure of Francophone cultures.

Grammatical Aspects:
Future Tense-Verbs used

Text Books:
1. Dominique, Philippe, et al. 1999. Le Nouveau sans Frontières -I (Including Exercise Book). Paris: Clé, International (Indian Edition).

Reference Books:
1. Alter Ego I & II. Published by Hachette
2. Connexion I & II. Published by Didier
3. Echo I & II. Clé International publishers
4. Latitude I & II. Published by Didier

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16EN4148 – FOREIGN LANGUAGE - SPANISH
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Identify Spanish sounds and participate in social interactions.
2. Read authentic texts in Spanish.
3. Write small and simple messages in Spanish.
4. Understand the nuances of Hispanic culture.

Course Outcomes:
At the end of the course, student would be able to:
CO 1. Apply basic vocabulary and grammatical structures in Spanish.
CO 2. Demonstrate competence in functional and grammatical structures of the language.
CO 3. Read with accurate pronunciation.
CO 4. Participate in simple conversations based on everyday situations.

UNIT–I
Functional Aspects:
Greetings, introductions, asking/giving information, pronunciation and Spellings - Hispanic names, family relations, professions, days of the week and months, nationalities, languages.

Grammatical Aspects:
Basic structure of spelling and pronunciation; present indicative of the regular verbs ('ar/er/ir) and 'querer'; subject pronouns; interrogative sentences with 'Porque', and 'quien'; causal phrase with 'porque'; 'ser' and 'estar'; negative sentences; adjectives of nationality.

UNIT–II
Functional Aspects:
Ordinal and cardinal numbers, quantities, shopping, describing things (material, colour, size etc.) and people (food habits, dress etc.)

Grammatical Aspects:
Gender and number of nouns and adjectives; the verb 'tener'; interrogative Sentences; demonstrative and qualitative adjectives.

UNIT–III
Functional Aspects:
Polite expressions- expressing opinions, making suggestions, expressing ideas and dislikes, agreeing and disagreeing.

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Grammatical Aspects:

Qualitative adjectives, forms and usage, gradations, superlative adjectives, exclamatory sentences; the verb 'gustar', forms and syntax; personal Pronouns; definite and indefinite pronouns, direct object pronouns, Prepositions; verbs like 'parecer' and 'encontrar and preferir, their form and syntax, interrogative pronouns.

UNIT–IV
Functional Aspects:

Invitations; accepting and refusing invitations; fixing an appointment; Inviting through telephone and or e-mail.

Grammatical Aspects:

Present indicative of irregular verbes, expressions with 'tener' and 'estar'; Prepositional pronouns; interrogative sentences.

UNIT–V
Functional Aspects:

Expression of time; Making comparisons - Indian and Hispanic. Describing events - festivals - Indian and Hispanic

Grammatical Aspects:

Time with 'ser', expression s relating to festivals.

Text Book:
 1. NOUVEAU ELE INICIAL 1

Reference Books:
 1. Espanol sin Fronteras, A. Sanchez, M. Rios, J.A. Metella, SGEL. Madrid, 1997
 2. Entre Nosotros A. Sanchez, M. Rios, J.A. Metella, SGEL. Madrid, 1997

Geethanjali College of Engineering and Technology (Autonomous)
Cheeryal (V), Keesara (M), Medchal Dist., Telengana-501301
16EN4149 – FOREIGN LANGUAGE - GERMAN
OPEN ELECTIVE - III

IV Year. B.Tech. CE– I Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Understand and participate in social interactions in everyday situations.
2. Write simple messages in German on topics related to personal interest and everyday life.
3. Read authentic texts in German.
4. Demonstrate insight into significant cultural products and historical events in German.

Course Outcomes:
At the end of the course, student would be able to:
CO 1. Converse in day to day situations.
CO 2. Demonstrate proficiency in writing.
CO 3. Read with accurate pronunciation.
CO 4. Display greater insight of German culture.

UNIT–I
Functional Aspects:
Greetings, introductions, asking/giving information, pronunciation and Spellings – German names, family relations, professions, days of the week and months, nationalities, languages.

Grammatical Aspects:
Definite and Indefinite articles (including negation)
Noun: Gender and Plural forms, cases (nominative, accusative, dative & genitive)

UNIT–II
Functional Aspects:
Ordinal and cardinal numbers, quantities, shopping, describing things (material, colour, size etc.) and people (food habits, dress etc.)

Grammatical Aspects:
Verb: Strong and Weak verbs, Verbs with separable and inseparable prefixes, modal verbs, position of verb in the main and subordinate clauses, auxiliary verbs, reflexive verbs in accusative and dative cases, imperative constructions

UNIT–III
Functional Aspects:
Polite expressions- expressing opinions, making suggestions, expressing ideas and dislikes, agreeing and disagreeing.

Grammatical Aspects:
Pronouns: personal, possessive, reflexive, interrogative and demonstrative, Prepositions: with the accusative, dative and with both these cases

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UNIT–IV
Functional Aspects:
Invitations; accepting and refusing invitations; fixing an appointment; Inviting through telephone and or e-mail.

Grammatical Aspects:
Adjective: declension with the Indefinite article, Definite article, without article, with the indefinite pronoun, Degrees of comparison (also adverbs), ordinal numbers, adjectives as nouns
Conjunctions: subordinating and coordinating with respect to the position of the verb.

UNIT–V
Functional Aspects:
Expression of time; Making Comparison - Indian and Germanic. Describing events - festivals - Indian and Germanic.

Grammatical Aspects:
Negation: of a sentence and words therein. .Sentence structure: general principles observed in German Language.

Text Book
 1. Hermann Funk, Christina Kuhn, Oliver Bayerlein., Studio d A 1.2005 Comelsen Verlag, Berlin.

Reference Book(s)
 1. Rosa –Marie Dallapiazza, Eduard von Jan, Till Schonherr,unter Mitarbeit von Jutta Orth-Chambah.
 2. Tangram aktuell 1 –Lektion 1-4, Lektion 5 - 8
 3. Max Hueber Verlag. Munchen. 2009

Geethanjali College of Engineering and Technology (Autonomous)
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16CE4110-FINITE ELEMENT METHODS FOR CIVIL ENGINEERING
SOFT CORE - II

IV Year. B.Tech. CE-I Semester
Pre Requisites:
16CE3101 STRUCTURAL ANALYSIS

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand fundamental concepts of theory of the finite element methods.
2. Understand the proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Understand the fundamental theory of the FEA method
CO 2: Understand the theoretical foundations of the advanced finite element methods (FEM) applied in civil engineering
CO 3: Understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements
CO 4: Understand the main assumptions and features of specialized structural elements and analysis types (such as linear and nonlinear static, eigenvalue and time-dependent problems)
CO 5: Ability to apply the most relevant advanced finite element methods in civil engineering by implementing well-structured programs for solving basic engineering problems
CO 6: Ability to critically utilize advanced finite element software tools.

UNIT – I

Introduction to Finite Element Method – Basic Equations in Elasticity Stress – Strain equation – concept of plane stress – plane strain advantages and disadvantages of FEM. Element shapes – nodes – nodal degree of freedom Displacement function – Natural Coordinates – strain displacement relations.

UNIT – II

Lagrangian – Serendipity elements – Hermite polynomials – regular, Irregular 2 D & 3D – Element –shape functions up to quadratic formulation.
Finite Element Analysis (FEA) of – one dimensional problems – Bar element – Shape functions stiffness matrix – stress – strain relation

UNIT – III

FEA Beam elements – stiffness matrix - shape function– Analysis of continuous beams.

UNIT – IV

FEA Two dimensional problem – CST – LST element – shape function – stress – strain.
Isoparametric formulation – Concepts of, isoparametric elements for 2D analysis -formulation of CST element.

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UNIT-V
Analysis of Trusses and Frames: Finite element analysis of trusses – Plane stress and plane strain problems using constant strain triangle elements – Analysis of rigid plane frames using two noded beam elements.

Text Books:
1. Introduction to Finite Elements in Engineering, Tirupathi R. Chandrupatla, and Ashok D. Belegundu, N.J. Pearson, 2012.
2. Finite Element Method with Applications in Engineering, Y.M. Desai, T.I. Eldho and A.H.Shah, Pearson Education India, First Edition, 2011.
3. An Introduction to the Finite Element Method, J. Reddy, McGraw Hill Education, 3rd Edition, 2017

Reference Books:
1. A first course in Finite Element Method, Daryl L. Logan, Cengage Learning India Pvt. Ltd, 2015.
2. Finite Element Method: Its Basic and Fundamentals, O.C Zienkiewicz and R.L. Taylor, Elsevier India, 6th Edition, 2007
3. Finite Element Analysis, P.Seshu, PHI Learning Private Limited, 2012.
4. Finite Element Analysis, S.S. Bhavikatti, New Age Publications, 2010.
5. Concepts and applications of Finite Element Analysis, Robert D. Cook et al., Wiley India Pvt. Ltd, 2002.
6. Applied Finite Element Analysis, G.Ramamurty, I.K.International Publishing House Pvt. Ltd., 2010.

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16CE4111- PAVEMENT ANALYSIS AND DESIGN
SOFT CORE - II

IV Year. B. Tech. CE– I Semester.
Prerequisite(s):
16CE3104 Transportation Engineering.

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand the concepts used to analyze flexible - rigid pavements.
2. Appreciate design of flexible & rigid pavement using IRC approach.
3. Apply the various types of construction procedures for pavement layers.
4. Learn factors affecting pavement design, material characteristics, design of flexible, rigid pavements and low volume roads.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain design factors for flexible and rigid pavements.
CO 2: Explain the assumptions in pavement layers and carryout design of flexible and rigid pavement.
CO 3: Discriminate methods of highway constructions used in pavement layers.
CO 4: Carryout evaluation pavement design.

UNIT – I
Introduction to Pavements: Variables Considered in Pavement Design-Types of Pavements - Functions of Individual Layer - Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles- Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure - Contact Pressure - EAL and ESWL Concepts - Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane, Directional Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads.

UNIT – II
Stresses in Pavements: Vehicle-Pavement Interaction: Transient, Random & Damping Vibrations, Steady State of Vibration, Experiments on Vibration - Stress Inducing Factors in Flexible and Rigid pavements.
Stresses in Flexible Pavements: Visco-Elastic Theory and Assumptions - Layered Systems Concepts - Stress Solutions for One, Two and Three-Layered Systems, Fundamental Design Concepts.
Stresses in Rigid Pavements: Westergaard's Theory and Assumptions - Stresses due to Curling, Stresses and Deflections due to Loading - Frictional Stresses - Stresses in Dowel Bars & Tie Bars.

UNIT – III
Material Characteristics: CBR and Modulus of Subgrade Reaction of Soil - Mineral aggregates – Blending of aggregates, binders, polymer and rubber modified bitumen - Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes - Permanent Deformation Parameters and other Properties - Effects and Methods of Stabilisation and Use of Geo Synthetics.

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UNIT - IV
Design of Flexible Pavements: Flexible Pavement Design Concepts, Asphalt Institute's Methods with HMA and other Base Combinations- AASHTO, IRC Methods

Design of Rigid Pavements: Calibrated mechanistic design process, PCA, AASHTO & IRC Specifications, Introduction to Prestressed and Continuously Reinforced Cement Concrete Pavement design.

UNIT – V
Design of Pavement for Low Volume Roads: Pavement design for low volume roads - Rural road designs – code of practice.

Design of Overlays: Types of Overlays - Suitability – Design of Overlays.

Text Books:
1. Principles and Practices of Highway Engineering, Dr. L.R. Kadyali and Dr. N.B. Lal, Khanna publishers, 2013.
2. Principles of Pavement Design, E.J. Yoder, M.W. Witczak, Wiley India Pvt Ltd., 2015.

Reference Books:
1. Design of Functional Pavements, Nai C. Yang, McGraw Hill Publications.
2. Pavement and Surfacings for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.
3. Pavement Analysis & Design, Yang H. Huang, Pearson Publications, 2010.
4. IRC Codes for Flexible and Rigid Pavements design.
5. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers.

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16CE41L1–COMPUTER AIDED STRUCTURAL DRAFTING LABORATORY

IV Year. B.Tech. CE– I Semester.
Prerequisite(s):
16ME1101-Engineering Drawing
16CE3102- Design of Reinforced Concrete Structures
16CE3201-Design of Steel Structures

L	T	P/D	C
-	-	3	2

Course Objectives:
Develop ability to:
1. Provide hands on experience for structural drafting.
2. Understand different commands in Auto CAD.
3. Understand plans, sections and elevations of the building.
4. Draw the structural detailing of RCC and STEEL structures as per IS specifications.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Draw the basic geometrical sections using different commands in AutoCAD.
CO 2: Draw plan & elevations of single and multi-storey building.
CO 3: Draft structural detailing of RCC elements like beams, columns & slabs.
CO 4: Draft structural detailing of STEEL-connections, compression members, plate girders.

LIST OF EXERCISES:

1) Introduction to computer aided drafting.
2) Commands in CAD.
3) Basic practice exercises on CAD.
4) Drawing of plans & elevations of
   (a) Single storey building.
   (b) Multi-storey building.
5) Reinforcing detailing of RCC singly reinforced, doubly reinforced beams.
6) Structural detailing of one way slab, two way slab.
7) RCC detailing of square, rectangular columns.
8) Drawing of STEEL-bolted, welded connections.
9) Detailing of compression members i.e., column (laced & battened).
10) Detailing of plate girder.

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16CE41L2– FEM FOR CIVIL ENGINEERING LAB
SOFT CORE – II LAB

IV Year. B.Tech. CE-I Semester.
Prerequisite(s): None.

L	T	P/D	C
-	-	3/-	2

Course Objectives:
Develop ability to:
1. Apply vector mechanics as a tool for problem solving.
2. Understand the need in Design for the Finite Element Method.
3. Tie his/her understanding of mechanical engineering design concepts to use the Finite Element Method software correctly and efficiently.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS general-purpose software;
CO 2: Model multi-dimensional heat transfer problems using ANSYS;
CO 3: Demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purposes;
CO 4: Develop basic understanding of the limitations of the FE method and understand the possible error sources in its use.

LIST OF EXERCISES:

Analysis of:
1. Bars of constant cross-section area.
2. Bars of tapered cross-section area.
3. Stepped bar.
4. Trusses.
5. Simply supported beam with point load.
6. Simply supported beam with UDL.
7. Simply supported beam with UVL.
8. Beam with moment and overhang
9. Cantilever beam with point load.
10. Cantilever beam with UDL
11. Beam with inclined loads, one end hinged and at other end roller support.
12. Rectangular plate with a circular hole.
13. Continuous beam.
14. Fixed beam.

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16CE41L3 - PAVEMENT ANALYSIS AND DESIGN LAB
SOFT CORE – II LAB

IV Year. B. Tech. CE– I Semester.
Prerequisite(s):
16CE3104 Transportation Engineering

L	T	P/D	C
-	-	3/-	2

Course Objectives:
Develop ability to:
1. Creation and annotation of 3D project models - Interoperable data base
2. Creation and analysis - Digital terrain data base.
3. Integration with google earth.
4. Tackling the design of any type of road, large or small.

Course Outcomes:
At the end of the course, student would be able to:
CO1: Create design alternatives to achieve the "ideal" road system and then automate the design detailing process, saving time and money.
CO2: Create and analyse horizontal and vertical alignment of a road.
CO3: Calculate volume and quantity of extraction (earthwork calculations).
CO4: How to design 2D, 3D drainage design.
CO5: Design and analyse the road and junction.

LIST OF EXERCISES:

1. Introduction to MX Roads-String Modelling
2. Survey data input and import
3. String names and drawing styles, point selection methods
4. Surface checker and editing data- surface analysis
5. String creation and editing
6. Earth work calculation
7. Alignment creation
    a. Horizontal alignment
    b. Vertical alignment
8. Design of rule based super elevation
9. Junction design
10. Pavement design -final drawings.

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16CE4201 - CONSTRUCTION TECHNOLOGY AND PROJECT MANAGEMENT

IV Year. B.Tech. CE– II Semester.
Pre Requisite(s):
16CE2101 Building Materials, Construction & Planning

L	T	P/D	C
4	-	-/-	4

Course Objectives:
Develop ability to:
1. Understand how to deal with overall planning, coordination and control of projects.
2. Impart knowledge of construction technology, scheduling, optimizing methods involving the construction of structures.
3. Understand scientific principles involved in construction, an understanding of the behaviour of construction materials and fundamentals of structural mechanics, construction practices.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Handle project planning and scheduling.
CO 2: Identify methods of project management for completion within stipulated time.
CO 3: Explain the equipment involved and technology used in the construction a projects.
CO 4: Apply qualitative methods of construction for a given project.

UNIT -I
Management process- Roles management theories Social responsibilities planning and strategic management strategy implementation. Decision making: tools and techniques – Organizational structure. Human resource management- motivation performance- leadership.

UNIT-II
Classification of Construction projects, Construction stages, Resources- Functions of Construction Management and its Applications .Preliminary Planning- Collection of Data-Contract Planning – Scientific Methods of Management: Network Techniques in construction management - Bar chart, Gant chart, CPM, PERT- Cost & Time optimization.

UNIT-III
Resource Planning - planning for manpower, materials, costs, equipment. Labour - Scheduling .Forms of scheduling - Resource allocation, budget and budgetary control methods

UNIT-IV
Contract - types of contract, contract document, specification, important conditions of contract – tender and tender document - Deposits by the contractor – Arbitration, negotiation - M.Book - Muster roll -stores.

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UNIT-V

Management Information System - Labour Regulations: Social Security - welfare Legislation - Laws relating to Wages, Bonus and Industrial disputes, Labour Administration - Insurance and Safety Regulations - Workmen's Compensation Act -other labour Laws - Safety in construction: legal and financial aspects of accidents in construction. Occupational and safety hazard assessment. Human factors in safety, legal and financial aspects of accidents in construction. Occupational and safety hazard assessment

Text Books:

1. Construction Technology, Subir k Sarkar, Subhajit Saraswati, Oxford University Press, 2009.
2. Construction Planning and Management, P.S. Ghalot, D.M. Dhir, New Age International Pvt. Ltd., 2014.

Reference Books:

1   Construction Management and Planning, B. Sengupta and H. Guha, McGraw Hill Education, 2015.
2   Construction planning, Equipment and methods, R. Peurifoy, Schexnayder, Shapira, McGraw Hill Education, 2013.
3   Construction Project Management, K.K. Chitkara, McGraw Hill Education, 2014.
4   Project Planning and Control with PERT and CPM, B.C. Punmia, Laxmi Publications, 2016.

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16CE4202–STRUCTURAL DYNAMICS
PROFESSIONAL ELECTIVE - III

IV Year. B.Tech. CE– II Semester.
Prerequisite(s):
16CE3101 Structural Analysis
16CE4102 Advanced Structural Analysis

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand different methods to analyze structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses, etc.
2. Understand analytical methods and procedures in a way that emphasize physical insight.
3. Apply structural dynamics theory to real-world problems like seismic analysis and design of structures.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Apply the knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
CO 2: Explain the dynamic response on various beams.
CO 3: Interpret dynamic analysis results for design, analysis and research purposes .
CO 4: Apply structural dynamics theory to earthquake analysis, response, and design of structures.

UNIT-I
Introduction: Mass- spring-damper idealization of structural systems, equation of motion for SDOF system, solution of the differential equations viscous damping, , under-damped, critically damped and over-damped systems, logarithmic decrement, determination of damping in the system.

UNIT-II
Lumped mass MDOF systems: Rayleigh method of determination of natural frequencies, Stodola-Vianelle method, Rayleigh method, Modified Rayleigh-Ritz method; multistorey rigid frames subjected to lateral loads, damping in multi degree systems.

UNIT-III
Structures with distributed mass and load: Introduction, free vibration, frequency and motions of simply supported beam, cantilever beam, fixed beam, propped cantilever beam, forced vibration of beams, Beams, with variable cross-section and mass.

UNIT-IV
Approximate design methods; Idealized system; transformation factors; dynamic reaction response calculations;
Design example (RC beam, steel beam), Stiffeness method and flexibility method.

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UNIT-V
Response to impulse loading: General nature of impulsive loading, sine-wave impulse, Rectangular impulse, square pulse of finite duration, triangular impulse, response to general force pulse, greens function, forced vibration.

Text Books:
1. Structural Dynamics, Mario Paz, C.B.S Publishers, 2012.
2. Dynamics of Structures, Anil K. Chopra, Pearson Education India, 2012.

Reference Books:
1. Dynamics of Structures, W. Clough & Joseph Penzien, McGraw Hill Education.
2. Structural Dynamics, John M. Biggs, McGraw Hill Education.
3. Structural Analysis, A. Ghali & A.M. Neville CRC Press, 2017.
4. Elements of earthquake engineering, Jai Krishna, Chandrasekaran, Brijesh Chandra, South Asian Publishers, 2000.
5. I.S: 1893 - 1984, "Code of practice for Earthquake resistant design of Structures" and latest I.S:1893 - 2002 (version) Part-1

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16CE4203–SOIL DYNAMICS AND MACHINE FOUNDATION
PROFESSIONAL ELECTIVE - III

IV Year. B.Tech. CE– II Semester.
Prerequisite(s):
16CE3105 Geotechnical Engineering
16CE3202 Foundation Engineering

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Familiarize students with wave propagation and the dynamic properties of soil
2. Understand importance of designing machine foundation for reciprocation and impact machines
3. Understand mechanism of liquefaction.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain theory of vibrations and its characterstics.
CO 2: Explain the method of determining the Natural frequency of foundation soil.
CO 3: Design different types of machine foundation.
CO 4: Determine liquefaction potential of soil.
CO 5: Explain properties of isolation materials.

UNIT–I
Fundamentals of Vibration: Definitions, Simple harmonic motion, Free and Forced vibrations with and without damping, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.

UNIT–II
Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits .Stress-strain behaviour of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties - field testing techniques,
Natural frequency of foundation soil system- Barkan's and I.S methods of determining natural frequency. Tschebotarioff's reduced natural frequency

UNIT–III
Liquefaction of soils: Definitions,Mechanism of liquefaction,laboratory studies, Dynamic triaixal tests, cyclic simple shear test,comparision of cyclic stress causing liquefaction under triaxial and shear tests. Standard curves and correlation for liquefaction,

UNIT–IV
Vibration Isolation: Types & Methods of isolation. Active isolation and passive isolation. Dynamic properties of isolation materials. Case studies pertaining to vibration problems of foundation.

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UNIT–V
Design of Machine Foundations: Types of machine foundation. General requirements, permissible amplitudes and bearing pressures. Analysis and design requirements of foundations for rotary, reciprocating and impact type of machines as per I.S code

Text Books:
1. Soil Dynamics and Machine Foundations, Swami Saran, Galgotia Publications (P) Ltd, 2016.
2. Foundation for Machines: Analysis and Design, Prakash Shamsher and Vijay K. Puri, John Wiley & Sons, 1988.

Reference Books:
1. Handbook of Machine Foundations, P. Srinivasalu & C. Vaidyanathan, McGraw Hill Education, 2017.
2. Advanced Soil Dynamics and Earthquake Engineering, Bharat Bhushan Prasad, PHI learning, 2012.
3. Principles of Soil Dynamics, Braja M. Das and G.V Ramana, Cengage Learning, 2014.
4. Dynamics of Structure and Foundation, Indrajit Chowdhury and Shambu P. Dasgupta, CRC Press, 2008.

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16CE4204 – ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT
PROFESSIONAL ELECTIVE - III

IV Year. B.Tech. CE– II Semester.
Prerequisite(s):
16CE3203 – Environmental Engineering.

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand various aspects of Environmental Impact Assessment methodologies.
2. Comprehend the impact of development activities on environment.
3. Understand the impact of a project on surface water, air and biological environment.
4. Assess the role of Environmental legislation.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Identify the environmental attributes to be considered for the EIA study.
CO 2: Formulate objectives of the EIA studies.
CO 3: Identify suitable methodology and prepare rapid EIA.
CO 4: Prepare EIA reports and environmental management plans.
CO 5: Plan the methodology to monitor and review the relief and rehabilitation works.

UNIT–I
Basic concepts of EIA: Initial environmental examination, Elements of EIA – factors affecting EIA. Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters. EIA Methodologies: Introduction, Criteria for selection of EIA Methodology, EIA methods, Ad-hoc methods, matrix methods, Network method. Environmental Media Quality Index method, overlay methods, cost/ benefit analysis.

UNIT–II
Assessment of Impact of development activities on Vegetation and wildlife, environmental impact of deforestation – Causes and effects of deforestation.

UNIT–III
Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures.

UNIT–IV
Environmental Audit and Environmental legislation, Objectives of Environmental Audit, Types of environmental audit, Audit protocol, stages of Environmental audit, onsite activities, evaluation of audit data and preparation of Audit report, Post audit activities.

UNIT–V
The Environmental Protection Act, The Water Act, The Air (Prevention & Control of pollution act), Motor Act, Wild life Act, Case studies and preparation of Environmental Impact assessment statement for various Industries.

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Text Books:
1. Environmental Impact Assessment Methodologies, Y. Anjaneyulu and Valli Manickam, B.S. Publications, Second Edition, 2010.
2. Environmental Impact Assessment, Larry Canter, McGraw-Hill Education, 2000.

Reference Books:
1. Environmental Impact Assessment, R.R. Barthwal, New Age International Publishers, 2014.
2. Environmental Impact Assessment, John G. Rau and David C. Wooten, McGraw Hill Education.
3. Environmental Impact Assessment: Theory & Practice, Peter Wathern, Routledge Publishers, 1998.
4. Environmental Pollution and Control, H.S. Bhatia, Galgotia Publications Pvt Ltd, 2003.
5. Environmental Pollution, Dr. R.K. Khitoliya, S.Chand Publishers, 2012.
6. Ministry of Environment and Forest website: http://envfor.nic.in/

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16CE4205- RAILWAY ENGINEERING
PROFESSIONAL ELECTIVE - III

IV Year. B. Tech. CE– II Semester.
Prerequisite(s):
16CE3104 Transportation Engineering

L	T	P/D	C
3	1	-/-	3

Course Objectives:
Develop ability to:
1. Understand the basics and design of various components of Railway Engineering.
2. Understand the requirements for designing the railway tracks and the material required for the construction of permanent way.
3. Apply the design concepts of super elevation of railway curves.
4. Understand the types and functions of track, junctions and railway stations.

Course Outcomes:
At the end of the course, student would be able to:
CO 1: Explain the importance of railway infrastructure planning and design.
CO 2: Identify the factors governing design of railway infrastructures.
CO 3: Design and analyze the railway track system.
CO 4: Explain the process of execution of railway projects.

UNIT-I
Introduction to Railways: Role of Indian Railways in national development – Railways for Urban Transportation – LRT, Mono Rail, Metro Rail & MRTS. Engineering Surveys for track alignment. Permanent Way: Components and their Functions: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks Sleepers – Functions, Materials, Density – Functions, Materials, Ballast less Tracks.

UNIT – II
Geometric Design of Railway Track: Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.

UNIT – III
Track maintenance and Operation: Points and Crossings - Turnouts, Working Principles, Automated maintenance and upgrading.

Signalling and Interlocking: Classification of Signals - Signalling System - Necessity and Functions of Interlocking- Track Circuiting -working principles- Track Maintenance.

UNIT-IV
Railway accidents: Human and system contribution to catastrophic accidents, Human Factors in Transport Safety, Unprotected level crossings, Safety Audit.

Railway Stations and Yards: Classification – Site Selection for Railway Stations and Yards – Lay Outs of Different Types of Stations – Functions of Different Types of Yards.

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UNIT-V
Design of Tracks for High Speeds: Geometrical Requirements, Challenges, Ballasted or Ballast less, Design methodology, Structural model, Dynamics analysis, Maintenance considerations.

Text Books:
1. A Textbook of Railway Engineering, S.C. Saxena and S.P. Arora, Dhanpat Rai Publishers, 2017.
2. Railway Engineering, Satish Chandra & M. M. Agarwal, Oxford University Press, 2016.

Reference Books:
1. Indian Railway Track, M.M Agarwal, Prabha and Co., 2017.
2. Railway Engineering, S.C. Rangwala, Charotar Publishing House, 2016.

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16MB4251– ENTREPRENEURSHIP
OPEN ELECTIVE - IV

IV Year. B.Tech. CE– II Semester.
Prerequisite(s): None.

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Understand the mindset of the entrepreneurs.
2. Analyze the financial aspects of establishing an enterprise.
3. Learn entrepreneurial activities and determine strategies for launching.
4. Identify the challenges of entrepreneurship and develop an idea on the entrepreneurial framework.
5. Apply strategic perspectives in entrepreneurship.

Course Outcomes:
At the end of the course, student would be able to:
CO1 Explore and identify the entrepreneurial traits.
CO2 Identify various funding agencies and role of IPR.
CO3 Imagine and identify opportunities to launch new ventures.
CO4 Address entrepreneurial challenges.
CO5 Develop strategies for bringing stability and growth in business.

UNIT-I: Introduction to Entrepreneurship
Meaning, importance, entrepreneurship characteristics, women entrepreneurs, classifications of entrepreneurs, myths of entrepreneurship, qualities of entrepreneurship, competencies, attitude function and nature of forms of entrepreneurship.

UNIT-II: Promotion and financial aspects of entrepreneurship
Idea generation- opportunities- SWOT analysis, patents and trademark, intellectual property rights, source of capital, debt capital, seed capital, venture capital- informal agencies in financing entrepreneurs. Government grants and subsidies, types of investors and private offerings.

UNIT-III: Launching entrepreneurial ventures
Opportunities identification- entrepreneurial imagination and creativities – the nature of the creativity process innovation and entrepreneurial- methods to initiate venture creating, new ventures-acquiring and established entrepreneurial venture, franchising hybrid-disadvantage of franchising.

UNIT-IV: Legal challenges of entrepreneurship
Intellectual property protection patents, copy rights-trademarks and trade secret. Avoiding pitfalls-formulation of the entrepreneurial plan-the challenges of new venture startups-poor financial understanding-critical factors for new venture development, the evaluation process, feasibility criteria approach.

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UNIT-V: Strategic perspectives in entrepreneurship

Strategic planning-strategic actions-strategic positioning-business stabilization-building the adoptive firms-understanding the growth stage unique managerial concern of growing ventures.

Text Books:

1. D F Kuratko and T V Rao "Entrepreneurship- A South - Asian Perspective "Cengage Learning, 1/e, 2012.
2. Vasanth Desai "Small Scale industries and entrepreneurship" Himalaya Publishing 2012.

Reference Books:

1. B. Janakiram and M. Rizwana "Entrepreneurship Development: Text & Cases, Excel Books, 2011.
2. Stuart Read, Effectual Entrepreneurship, Routledge, 2013.
3. Nandan H, Fundamentals of Entrepreneurship, PHI, 2013.

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16CS4252 – WEB DEVELOPMENT
OPEN ELECTIVE - IV

IV Year. B.Tech. CE– II Semester.
Pre Requisites: **None.**

L	T	P/D	C
3	-	-/-	3

Course Objectives
Develop ability to:
1. Understand the basic web concepts and Internet protocols
2. Understand XML and processing of XML data
3. Understand client side scripting with Javascript and DHTML
4. Understand server side programming with PHP
5. Understand file handling and database connectivity with PHP

Course Outcomes (COs):
At the end of the course, student would be able to:
CO1. Create dynamic and interactive web sites
CO2. Write and execute client side scripts using Javascript and DHTML.
CO3. Write, parse and execute XML schemas.
CO4. Write, implement, deploy and execute server side programs and components using PHP.
CO5. Handle files, store, retrieve and process data using database connectivity with PHP.

UNIT I:
HTML: Common Tags – List, Tables, images, forms, frames; Cascading Style Sheets.

Client side Scripting: Introduction to JavaScript: JavaScript language – declaring variables, Scope of variables, functions, event handlers (on click, on submit etc.), Document Object Model, Form validation.

UNIT II:
XML: Introduction to XML, Defining XML tags, their attributes and values, Document Type Definitions, XML Schemas, Document Object Model, XHTML

Parsing XML Data – DOM and SAX Parsers in Java.

UNIT III:
Introduction to PHP: Declaring variables, data types, arrays, strings, operators, expressions, control structures, functions, Reading data from web form controls like text boxes, radio buttons, lists etc., Handling File Uploads, Http sessions and cookies.

UNIT IV:
File Handling PHP: File operations like opening, closing, reading, writing, appending, deleting etc. on text and binary files, listing directories.

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UNIT V:
Connecting to Database (MYSQL as reference), executing simple queries, Storing form data into tables, handling results.

Text Books:
1. Web Technologies, Uttam K Roy, Oxford University Press.
2. The Complete Reference PHP – Steven Holzner, Tata McGraw – Hill.

Reference Books:
1. Web Programming, building internet applications, Chirs Bates 2nd edition, Wiley Dreamtech.
2. Java Server Pages – Hans Bergsten, SPD O"Reilly.
3. Java Script, D.Flanagan, O"Reilly, SPD
4. Beginning Web Programming – Jon Duckett WROX.
5. Programming world wide web, R.W.Sebesta, Fourth Edition, Pearson.
6. Internet and world wide web – How to program, Dietel and Nieto, Pearson.

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16EE4253– RENEWABLE ENERGY SOURCES
OPEN ELECTIVE - IV

IV Year. B.Tech. CE– II Semester.
Prerequisite(s): None.

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Understand the basic concepts of solar energy
2. Understand the methods of storage of solar energy
3. Understand basic concepts of wind energy, biomass energy.
4. Understand basic concepts of geothermal energy and ocean energy
5. Understand the need of direct energy conversion.

Course Outcomes:
At the end of the course student would be able to:
- CO1. Get thorough knowledge on various types of renewable energy sources
- CO2. Develop storage systems of solar energy for different applications.
- CO3. Get thorough knowledge on hybrid energy systems
- CO4. Get thorough knowledge on principles of direct energy conversion
- CO5. Apply the above conceptual things to real world electrical and electronic problems

UNIT-I
Principles of solar radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II
Solar Energy Collection, Storage & Applications:
Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
Storage & Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating / cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT -III
Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Bertz criteria.
Bio-mass: Principles of Bio-conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C Engine operation and economic aspects.

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UNIT- IV
Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.
Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants and their economics.

UNIT-V
Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, and principles of DEC.

Text Books:
  1. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers.
  2. Introduction to renewable energy, Vaughn Neison, CRC Press (Taylor & Francis)

Reference Books:
 1. Renewable Energy Resources, Twidell & Wier, CRC Press (Taylor & Francis)
 2. Renewable Energy sources and Emerging Technologies, D.P. Kothari, K.C Singal, Rakesh Ranjan, PHI Learning Private Limited.
 3. Fundamentals of Renewable Energy systems, D. Mukherjee, S. Chakrabarty, New age International.
 4. Renewable Energy Power for a sustainable Future, Godfrey Boyle, Oxford University Press.

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16EC4254– BIOMEDICAL INSTRUMENTATION
OPEN ELECTIVE - IV

IV Year. B.Tech. CE– II Semester.
Prerequisite(s): None.
Note: No detailed mathematical treatment is required and only elementary treatment is sufficient.

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Learn the basics of human physiology
2. Understand the basics of bio-medical transducers and recorders.
3. Understand the applications of measuring, recording and monitoring instruments.
4. Understand the concepts of various medical instruments
5. Understand the concepts of various supporting systems.

Course Outcomes:
At the end of the course, student would be able to:
CO1. Explain the functioning of different human physiological systems.
CO2. Explain the operations of transducers and recorders used for bio-medical applications.
CO3. Explain the principles of medical imaging systems.
CO4. Explain the principles of monitoring instruments used for bio-medical application
CO5. Explain the need for health supporting systems

UNIT I - Human Physiology
Introduction to generalized medical instrumentation system, components of instrumentation system, physiological system of human body, cardiovascular system. Respiratory system, Nervous system, generation of bioelectric potentials, Action potential, resting potential, Neuronal communication.

UNIT II - Bio- Potential Electrodes, Transducers And Recorders
The electrode – electrolyte interface, Polarization, Ag/Agcl Electrodes, Body surface electrodes, Internal Electrodes. Transducers in general, PressureTransducers, Temperature transducers, pulse sensors, Basic recording systems.

UNIT III - Medical Imaging Systems
Basics of medical imaging systems, block diagrams and applications of - X-ray machine, Computer Tomography, Magnetic Resonance Imaging systems, Ultrasonic Imaging systems.

UNIT IV - Monitoring Systems
Basic principles of -Stethoscope, BP measuring Instrument, Electrocardiography(ECG), Electroencephalography(EEG) and Electromyography(EMG) recorders,

UNIT V - Supporting Systems
Basic principles of Pacemaker system, Transcutaneous Electrical Nerve stimulation (TENS), surgical diathermy, Heart lung machine, Hemo Dialysis, Lithotripsy.

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Text Books:
1. Cromwell, "*Bio-Medical Instruments and Measurements",* Prentice Hall of India, 1990.
2. Dr.Arumugam, "*Bio-Medical Instrumentation"*, Anuradha Agencies, 1994.

Reference Books:
1. Prof.Venkataram.S.K, "Bio-Medical Electronics & Instrumentation", Galgotia Publications, 2000.
2. John. Can. Brown, "Introduction to Bio Medical Equipment Technology", Pearson Education of ASIA, 2001.
3. Khandpur.R.S, "Hand book of Bio-Medical Instrumentation", Tata McGraw –Hill, 1987

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16ME4255– MATERIALS HANDLING
OPEN ELECTIVE - IV

IV Year. B.Tech. CE– II Semester.
Prerequisite(s): None.

L	T	P/D	C
3	-	-/-	3

Course Objectives
1. To know the working principle of earth moving equipment
2. To study types and working principle of conveying and hoisting equipment
3. To understand the working principle of concrete producing, concrete screening and concrete mixing equipment
4. To know the principle of pneumatic equipment and tools

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

CO1	Understand the basics of material handling systems by using earth moving equipments.
CO2	Understand working principles of various conveying systems used in industries.
CO3	Understand the process of aggregating the materials with crushers and screens.
CO4	Understand the working principles of pneumatic equipments.
CO5	Apply the various methods for cost minimization along with maintenances

UNIT-I: Introduction: Material handling principles; material handling equipment and material handling systems.

Earth moving and Excavation Equipment-Shovels, Dragline, Clam shell, Cable Excavator, Bucket Wheel Excavator, Tractor, Bull - dozer, Scraper, Earth compactors.

UNIT-II: Conveying Equipment: Belt Conveyor, Screw Conveyor, Bucket Conveyor, Aerial ropeway,

Hoisting Equipment: Hoist Winch, Differential and Worm geared chain hoists. Fork lift truck, Guyed derricks, Swing and non -swing mobile crane, Whirler crane, Tower crane.

UNIT -III: Aggregate and Processing Equipment: Crushers, Jaw, Gyratory, Hammer and Roll crushers; Screens: Stationary, Revolving, Shaking and Vibrating screens. Concrete mixers, Concrete pump. .

UNIT –IV: Pneumatic Equipment: Reciprocating air-compressor. Construction of pneumatic tools: Jack hammer, Paving breaker, Concrete vibrator and miscellaneous equipments.

UNIT-V: Cost minimization & Maintenance:
Cost minimization methods of material handling- Maintenance of Material Handling Equipments, Safety in material handling, Ergonomics of Material Handling equipment.

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Text Books:
1. Peurifoy R.L, " Construction Planning, Equipment and Methods", McGraw Hill 6th Edn., 2008.
2. Spence G and Wood C.L, "Building and Civil Engineering Plant' : John -Wiley & Sons, 2nd Edn., 2004.
3. Mahesh Varma Dr, "Construction Equipment & its Planning & Application': Metropolitan Book Co., 3rdEdn., 2009

Reference Books:
1. PB Mahapatra, Operations Management/ /PHI. January 2010.
2. James M. Apple, Plant Layout and Material Handling, John Wiley & Sons.2013.
3. Fred E. Meyers, Plant Layout and Material Handling, Prentice Hall, 25 January 1993.

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16MA4257– ACTUARIAL STATISTICS
OPEN ELECTIVE - IV

IV Year. B.Tech. CE– II Semester.
Prerequisite(s): None.

L	T	P/D	C
3	-	-/-	3

Course Objectives:
Develop ability to:
1. Determine present and future values of investment projects, annuities and be able to compute outstanding principal (capital) as well as interest using loan schedules.
2. Provide a motivation, based on a normative theory of individual behavior in the face of uncertainty, for the study of insurance models.
3. Measure the number of deaths (in general, or due to a specific cause) in a particular population, scaled to the size of that population, per unit of time.
4. Understand benefits of life insurance, various insurance policies, payments and premiums.
5. Predict future trends and patterns in the data behavior of processes or metrics over a period of time using time series models. Fit a model and proceed to forecasting and monitoring.

Course Outcomes:
At the end of the course, the student would be able to:
CO1. Assess financial loss and profit of an organization or in any business, shares.
CO2. Apply an economic theory that explains the mathematical expectation of the insured loss and profit.
CO3. Organize to assess various risks involved in terms of mortality, claims which can be received, profitability analysis for organization and individuals.
CO4. Analyze Life Insurance policies, Pension plans and Health Care Plans.
CO5. Apply time series models in Economic, Sales, Weather forecasting, Budgetary and stock market analysis, Inventory and Utility studies etc.

UNIT-I : Financial mathematics
Rate of Interest;Normal and effective rates of interest and discount; Accumulated Value; Present value of cash flows; Valuing Cash Flows; Present Value Principals of compound interest; force of interest and discount compound interest; Annuities certain; Deferred annuities, Concepts of different annuities, annuities due, Redemption of Loans, Sinking Funds and Capital redemption assurance.

UNIT-II : Utility Theory
Insurance and Utility Theory; Models for Individual Claims and their sums; Approximations for the distribution of Sums; Application to Insurance; Survival function Time until-death for a person age x; Curate future life time.

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UNIT-III : Mortality

Functions and laws of mortality tables; Select ultimate and aggregate mortality tables; Functions other than yearly policy Values; Surrender values and paid up Values; Bonus Special policies; Joint life and last survivor statuses; The Mortality tables.

UNIT-IV : Life Insurance and Premiums

Insurance payable at the moment's of death and at the end of the year of death-level benefit insurance; endowment insurance; differed insurance and varying benefit insurances; recursions; commutation functions; Single payment.Net Premiums and Net Premium Reserves of insurance policies; Insurance policies with expenses and bonuses introduced; Gross premiums and Gross premium reserves of insurance policies.

UNIT-V : Time Series Analysis and Forecasting

Basic concepts of Time Series Analysis; Components of Time Series: Moving Averages, Exponential Smoothing, Autoregressive and Partial Autoregressive Functions; Forecasting Models: Moving/Autoregressive Moving Averages (MA,AR,ARMA and ARIMA); Prediction limits, Forecast Updating and Holt-Winter's Methods; Box-Jenkins Method of modeling.

Text Books:

1. Actuarial Mathematics society of Actuaries, Itasca, IIIinos, USA Second Edition (1997), Newton.L.Bower, JR. Hanes.U. Gerber, James .C.Hickman, Donald. A.Jones and Cecil .J.Nesbitt (1986).
2. Actuarial Statistics: An Introduction Using R (2009) by Shailaja R. Deshmukh, Universities Press; Third edition

Reference Books:

1. Introduction to Time Series Analysis and Forecasting, Cheryl L. Jennings, Douglas C. Montgomery, and Murat Kulahci
2. An Introduction to Actuarial Mathematics, Springer-Science+Bussiness Media Dordrecht (2002),A.K.Gupta and T.Varga.
3. Fundamentals of Actuarial Mathematics, Second Edition, S. David Promislow
4. Life Contingencies, Spurgeon E.T. (1972), Cambridge University Press
5. Time series analysis, forecasting and control Book by George E. P. Box