

Faculty of Engineering & Technology  
KAKATIYA UNIVERSITY, WARANGAL-506 009  
Department of Civil Engineering

**B. Tech. (Civil Engineering) VII SEMESTER**

S.No	Course Code	Course Title	Scheme of Instruction			Lecture Hrs/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
<b>Theory</b>									
1.	PC4101CE	Estimation Costing and Specification	3	1	-	4	30	70	4
2.	PEC IV*	Professional Elective -IV	3	-	-	3	30	70	3
3.	PEC V*	Professional Elective -V	3	-	-	3	30	70	3
4.	PEC VI*	Professional Elective -VI	3	-	-	3	30	70	3
5.	OE I	Open Elective -I	2	-	-	2	30	70	2
<b>PRACTICALS</b>									
6.	PW4115CE	PROJECT WORK PART A	-	-	4	-	25	50	2
7.	PC4116 CE	Computer Aided Building Lab	-	-	3	-	25	50	1.5
		Total	14	1	7	15	200	450	18.5

**\* (PE-IV) PROFESSIONAL ELECTIVE COURSE -IV**

PE4102 CE	Analysis and Design of Bridges
PE4103 CE	Applied Hydrology
PE4104 CE	Road Safety Engineering

**\* (PE-V) PROFESSIONAL ELECTIVE COURSE -V**

PE4105 CE	Retrofitting and Rehabilitation of Structures
PE4106 CE	Elements of Earth Quake Engineering
PE4107 CE	Finite Element Analysis

**\* (PE-VI) PROFESSIONAL ELECTIVE COURSE -VI**

PE4108 CE	Railway Infrastructure Planning and Design
PE4109CE	Ground Water Management
PE4110 CE	Intelligent Transportation System

**\* OE I OPEN ELECTIVE I**

OE4111 EC	Optimization Techniques
OE4112 EC	Fundamentals of IOT
OE4113 ME	Basic Material Science and Engineering
OE4114 HS	IPR and Patenting

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**B. Tech. (CE) VII SEMESTER**  
**PC4101CE Estimation Costing and Specification**  
**(Professional Core Course)**

Course code	PC4101CE				
Category	Professional Core Course				
Course title	Estimation Costing and Specification				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	1	-	4	External Marks = 70

**UNIT – I**

**Basic Principles and Specifications:** General and detailed specifications of works, departmental procedures to the construction works, types of estimates, various types of contract, turnkey projects, essentials of contracts and conditions of contracts, schedule of rates, standard data, rate analysis, bill of quantities.

**UNIT – II**

**Tenders and Documentation:** Tenders, preparation of tenders, tender documentation, Tender notice, work order, earnest money deposit, and security money deposits, comparative statements, additional conditions mentioned by tender, and those implications. Measurement book and muster roll, advances in tender procedures. National/International bidding. BOT, BOOT and PPP projects. Role of IT in tenders and construction industry.

**UNIT – III**

**Estimation of Buildings and Roads:** Traditional residential buildings, advanced buildings (earth work, footings, columns, beams and slabs etc.) by long wall and short wall method and centre line method, bar bending schedules, estimation of reinforcement quantities.

**Estimation of road works:** Using levels (cross sections and longitudinal sections).

**UNIT – IV**

**Estimation of Irrigation Structures:** Pipe culvert, slab culvert, simple bridge, irrigation canal including earth work (cutting and banking), overhead water tank and aqueduct.

**UNIT – V**

**Software's in estimation:** Preparation of estimates using computer software/excel sheets/available software's, introduction to MS Project.

**Suggested Readings:**

1. Dutta, B.N. (2016). *Estimating and Costing in Civil Engineering: Theory and Practice*. UBS Publishers' Distributors Pvt. Ltd., New Delhi.
2. Chakraborti, M. (2002). *Estimating, Costing and Specifications in Civil Engineering*. Chakraborti, Kolkata.
3. Jagjit Singh. (1996). *Estimating and Costing in Civil Engineering*. Galgotia Publications, New Delhi

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**B. Tech. (CE) VII SEMESTER**  
**PE4102 CE Analysis and Design of Bridges**  
**(Professional Elective Course)**

Course code	PE4102 CE				
Category	Professional Elective Course				
Course title	Analysis and Design of Bridges				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

**UNIT - I**

Introduction - Introduction to bridge Engineering: Types of bridges, materials of construction, codes of practice (Railway and Highway bridges), aesthetics, loading standards (IRC, RDSO, AASHTO), recent developments, box girder bridges, historical bridges (in India and overseas), planning and layout of bridges, hydraulic design, geological and geotechnical considerations, Developments in road and urban infrastructure.

**UNIT - II**

Concrete Bridges - Materials requirements, precast systems and materials used for precast and cast in-situ bridges. Bridge deck and approach slabs, design of bridge deck systems, slab-beam systems design philosophies.

**UNIT - III**

Composite Bridges Importance of composite bridges, orthotropic decks, box girders, composite structures, concrete bridges, analysis and design of composite sections.

**UNIT - IV**

Sub-structures -Introduction to sub structures, design of Piers, columns and towers, analysis and design, shallow and deep foundations, caissons, abutments and retaining walls. Bridge components - Introduction, Expansion joints, design of joints, types and functions of bearings, design of elastomers bearing, railings, drainage system, lighting.

**UNIT-V**

Long Span Bridges - Introduction, design specifications, Design principles of continuous box girders, curved and skew bridges, cable stayed and suspension bridges, seismic resistant design, seismic isolation and damping devices. Construction Techniques - Cast in-situ, prefabricated, incremental launching, free cantilever construction, inspection, maintenance and rehabilitation, current design and construction practices. Innovative materials, construction techniques and methodologies.

**Suggested Reading :**

1. Wai-Fah Chen LianDuan, Bridge Engineering Handbook, CRC Press, USA,2000.
2. R. M. Barker, and J. A. Puckett, Design of Highway Bridges, John Wiley & Sons, New York, 1997.
- 3.P. P. Xanthakos, Theory and Design of Bridges, John Wiley & Sons, New York, 1994.

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**B. Tech. (CE) VII SEMISTER**  
**PE4103 CE Applied Hydrology**  
**(Professional Elective Course)**

Course code	PE4103 CE				
Category	Professional Elective Course				
Course title	Applied Hydrology				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

**UNIT – I**

**Flood Characteristics and Forecasting:** Measureable features of a flood (Elevation, discharge, volume, and duration), flood forecasting (unit hydrograph method, meteorological and snow data, and snow field air temperatures), operation of flood forecasting systems.

**Space-Time Characteristics of Rainfall:** Policy criteria for design flood of a major and minor reservoir, spillways, diversion dams and barrages, design flood criteria for dams and other hydraulic structures (CWC recommendations).

**UNIT – II**

**Flood Routing:** Mathematics of flood routing, various methods of flood routing, Hydrologic and Hydraulic routing.

**UNIT – III**

**Flood Mitigation:** Flood mitigation reservoirs (purpose, location, size and operation) levees and flood walls(location, maintenance and flood fighting), flood ways, channel improvement, evacuation and flood proofing, land management, flood plain management, estimating benefits of flood mitigation.

**UNIT – IV**

**Flood Plain Adjustments and Regulations:** Results of controlling floods, alternatives to controlling floods, range of possible adjustments, practical range of choice, critical characteristics of flood hazards, classification of flood plain land, and regulation of flood plain use, river training works (guide banks, approach and afflux embankments, spurs / groynes, artificial cut-offs, bank protection, pitched banks, and miscellaneous methods).

**UNIT – V**

**Hydrologic Time Series Analysis:** Independent and Auto-correlated data, structure of hydrologic time series, trend, jump, seasonality, stationary, Auto-covariance and Auto-correlation Function, Correlogram Analysis, spectral Analysis, Analysis of Multi-Variant Hydrologic series.

***Suggested Readings:***

1. VenTe Chow (1964), *Hand Book of Applied Hydrology*, McGraw-Hill Publishers, New York.
2. Linsley, R. K. and Franzini A. W. (1992), *Water Resource Engineering*, McGraw-Hill Publishers, New York.
3. Varshney, R. S. (1979), *Engineering Hydrology*, Nem Chand Publishers, Roorkee.
4. Jaya Rami Reddy, P. (1987), *A. Text Book of Hydrology*, Lakshmi Publishers, New Delhi.
5. Daniel H. Hoggan (1989), *Computer Assisted Flood Plain Hydrology and Hydraulics*, McGraw-Hill Publishers, New York.

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**B. Tech. (CE) VII SEMISTER**  
**PE4104 CE Road Safety Engineering**  
**(Professional Elective Course)**

Course code	PE4104 CE				
Category	Professional Elective Course				
Course title	Road Safety Engineering				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

**UNIT – I**

**Road Accidents:** Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics, Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

**UNIT – II**

**Safety in Road Design:** Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & Driver characteristics influencing road safety.

**UNIT – III**

**Road Signs and Traffic Signals:** Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, pedestrians' safety, fixed and vehicle actuated signals. Design of signals, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

**UNIT – IV**

**Traffic Management Techniques:** Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, One-way streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

**UNIT – V**

**Incident Management:** Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management programs. National importance of survival of Transportation systems during and after all natural disasters especially cyclones, earthquakes, floods etc. and manmade disasters like sabotage, terrorism etc.

***Suggested Readings:***

- 1.Guidelines on Design and Installation of Road Traffic Signals, IRC:93.
- 2.Specification for Road Traffic Signals, IS: 7537-1974.
- 3.Principles and Practice of Highway Engineering by L.R. Kadiyali and N.B. Lal.
- 4.Hand Book of T.E. Myer Kutz, Editor McGraw Hill, 2004.

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**B. Tech. (CE) VII SEMESTER**  
**PE4105 CE Retrofitting and Rehabilitation of Structures**  
**(Professional Elective Course)**

Course code	PE4105 CE				
Category	Professional Elective Course				
Course title	Retrofitting and Rehabilitation of Structures				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

#### UNIT – I

**Introduction to Building Maintenance:** Definitions of repair, renovation, re-modeling, restoration, retrofitting and rehabilitation. Need for maintenance, types of maintenance, routine maintenance works in buildings.

**Types of Defects and Damages in Structures:** During pre-construction stage, construction stage and post construction stage. Cracks – Types, Causes and Characteristics

#### UNIT – II

**Mechanisms of Deterioration of Structures & Their Prevention:** Concrete Structures: Defects in fresh concrete - Early frost damage, plastic shrinkage, plastic settlement (subsidence), sub grade settlement, formwork movements. Deterioration in hardened concrete: (a) Physical causes - aggregate shrinkage, drying shrinkage, crazing (b) Chemical causes: acid attack, sulphate attack, chloride attack, carbonation, alkaliaggregate reaction, corrosion of reinforcement, (c) Thermal causes: Freeze-thaw, temperature variations, differential thermal expansions, humidity influences, (d) Structural causes: improper design loads, accidental overloads, creep

**Steel Structures:** Causes and types of deterioration, mechanism of corrosion, prevention of deterioration, influence of design details, design and fabrication errors, stresses due to erection.

#### UNIT – III

**Condition Assessment and Non-destructive Testing & Evaluation:** Definition, objectives and stages of condition assessment, Destructive and partially destructive tests. Non-destructive tests (NDTs). Classification of NDT procedures, Visual Inspection, Ultrasonic Testing methods (Impact echo, Pulse velocity, Pulse echo), Rebound hammer (IS 13311), Windsor probe test, Half-cell potential measurement, Electrical resistivity measurement, Carbonation depth measurements, Petrographic Analysis, Electromagnetic methods for Rebar detection, Ground Penetrating radar, Infrared thermography, Radiography, Radio isotope gauges, Remote viewing, Hammer sounding, Chain drag techniques.

#### UNIT – IV

**Repair Materials and Techniques:** Repair Methodology, Repair materials (cement-based, polymer-based, resin based, micro Crete, composites, etc.), compatibility considerations, Repair techniques: Using mortars, dry pack, epoxy bonded pack, pre-placed aggregate concrete, gunite, shotcrete, grouting, polymerimpregnation, resin injection, routing & sealing, stitching, surface patching, overlays & surface coatings, auto genius healing, gravity filling, drilling and plugging

#### UNIT – V

**Retrofitting & Rehabilitation Procedures:** Strengthening of Existing Structures – Overview, general procedures, Techniques: section enlargement, composite construction, post-tensioning, stress reduction, strengthening by reinforcement, methods of strengthening in beams, slabs, columns (plate bonding, RC jacketing, FRP methods, concrete overlays, etc.) strengthening of substructure (shoring, underpinning)

***Suggested Readings:***

1. Varghese P. C. (2015), *Maintenance, Repair & Rehabilitation & Minor Works of Buildings*, PHI Learning Pvt. Ltd, Delhi.
2. Modi P.I. and Patel C.N. (2016), *Repair and Rehabilitation of Concrete Structures*, PHI Learning Pvt. Ltd, Delhi.
3. Peter H. Emmons, (2001), *Concrete Repair and Maintenance Illustrated*, Galgotia Publications, New Delhi.
4. Johnson.S.M., (1980), *Deterioration, Maintenance and Repair of Structures*, Krieger Publishing, Melbourne, Florida.
5. Guha. P.K., (1998), *Maintenance and Repairs of Buildings*, New Central Book Agency Ltd., Kolkata.
6. SP: 25-1984, (1999), *Handbook on Causes and Prevention of Cracks in Buildings*, BIS, New Delhi.
7. Guide Book on *Non-destructive Testing of Concrete Structures*, Training course series No. 17, International Atomic Energy Agency, Vienna, 2002.
8. Hand book on "*Repair and Rehabilitation of RCC Buildings*", Published by Director General, CPWD, Govt. of India, 2002



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**B. Tech. (CE) VII SEMESTER**  
**PE4106 CE Elements of Earth Quake Engineering**  
**(Professional Elective Course)**

Course code	PE4106 CE				
Category	Professional Elective Course				
Course title	Elements of Earth Quake Engineering				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

**UNIT-I**

Engineering Seismology: Causes of earthquakes, seismic waves, magnitudes, intensity and energy release, characteristics of strong earthquake ground motions, soils effects and liquefaction.

**UNIT - II**

Theory of Vibrations: Introduction, long and short period structure. Single, two and multi- degree of freedom systems. Concepts of damped and un-damped vibrations, response spectrum, response spectrum analysis.

**UNIT - III**

Structural Systems for Seismic Design: Requirements of an efficient earth quake resistant Structural System, Seismic Response Control Concepts, Seismic Behavior of Masonry Structures Base Isolation, Damping Device Rehabilitation and retrofitting: seismic retrofitting, repair, rehabilitation and retrofitting

**UNIT - IV**

Computation of Seismic Forces on the Structures- Earthquake Resistant Design of RCC Structures as per IS code - Equivalent Lateral Force Procedure, Dynamic Analysis Procedure, Lateral drift and P-A Analysis, Load Combination, Provision for the analysis and design of frames with soft storey, Effect of soil -structure Interaction

**UNIT - V**

Design and Detailing of RCC Building Structures: Ductility in RCC Structures, Ductile Detailing of Column and flexural members subjected to combined bending and axial load as per IS code. Reinforced Concrete Shear Wall

**Suggested Reading:**

1. Chopra, A.K.(2004).“Dynamics of structures, Theory and application to earthquake Engineering.”Pearson Education.
2. PankajAgarwal and Manish Shrihkande (2006).“Earthquake Resistance Design of Structures.”Prentice Hall ofIndia.
3. Kramer, S. L. (2004). Geotechnical Earthquake Engineering, PearsonEducation.
4. Mario Paz. (1995). International Handbook of Earthquake Engineering: Codes, programs and examples, Springer Verlag.
5. D.S.PrakashRao. (2005). Design principles and detailing of concrete structures, Tata McGraw-hillpublishingcompany.
6. VinodHosur (2016) "Earthquake Resistance Design of Structures." Wiley India Pvt Ltd

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**B. Tech. (CE) VII SEMESTER**  
**PE4107 CE Finite Element Analysis**  
**(Professional Elective Course)**

Course code	PE4107 CE				
Category	Professional Elective Course				
Course title	Finite Element Analysis				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

#### UNIT – I

**Introduction to Finite Method:** Variational approach, Rayleigh-Ritz and Galerkin's methods. Stiffness matrix for two noded bar, truss, and beam elements, problems with three degrees of freedom.

#### UNIT – II

**Stiffness Matrix:** Two noded beam element with three degrees of freedom per node. Transformation, generation of stiffness matrix for frames. Strain-displacement and stress – strain relationship in an elastic continuum (linear problems). Equations of equilibrium, and boundary conditions. Plane stress and plane strain problems.

#### UNIT – III

**Formulation of Finite Element Method:** Using principle of virtual displacement. Determination of stiffness matrix for three noded triangular element (constant strain triangle), and four noded rectangular element for plane stress and plane strain problems. Convergence criteria for selection of displacement models. Discretisation of continuum. Assembly of global stiffness and load matrices. Displacement boundary conditions.

#### UNIT – IV

**Isoparametric Finite Elements:** Direct construction of shape functions for higher order elements using natural co-ordinate system. Shape functions for eight noded parabolic curved iso-parametric element. Determination of element stiffness matrix for four noded quadrilateral element. Use of Jacobian, and Gaussquadrature techniques. Load matrix for eight noded rectangular isoparametric element (for body forces and surface traction).

#### UNIT – V

**Strain Displacement:** Stress – strain relation for axisymmetric problems. Stiffness matrix for three noded ring element. Volume co-ordinates and stiffness matrix for four noded tetrahedron element. Exposure to FEM based software's.

#### **Suggested Readings:**

1. O.C. Zienkiewicz and R.L. Taylor, *The Finite Element Method*, Vol. I, McGraw Hill, 1989.
2. K.J. Bathe, *Finite Element Procedures*, Pearson Education, 2006.
3. S. M. Jalaludeen, *Finite Element Analysis*, Anuradha Publications, 2016.
4. S.S. Bhavakatti, *Finite Element Analysis*, New Age International Publishers, 2005.
5. C.S. Krishna Moorthy, *Finite Element Analysis*, McGraw Hill, 1991.
6. T.R. Chandrupatla, *Finite Element Analysis for Engineering and Technology*, Universities Press, 2004

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**B. Tech. (CE) VII SEMESTER**  
**PE4108 CE Railway Infrastructure Planning and Design**  
**(Professional Elective Course)**

Course code	PE4108 CE				
Category	Professional Elective Course				
Course title	Railway Infrastructure Planning and Design				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

#### UNIT-I

General Features and Alignment of Railway Lines: Development in Indian railways, modes of transport, organization of Indian railways, finances and their control commission of railway safety, long term planning process, classification of railway lines, general features of Indian railways, impartment statistics. Alignment of railway lines, railway track gauge, engineering surveys.

#### UNIT-II

Rails, Sleepers, Track and Track Stresses: Requirements of good track, Maintenance of permanent way, track as an elastic structure, coning of wheels, tilting of rails. Functions of creep, creep adjuster, measures to reduce creep. Sleepers; functions and requirements, sleeper density and spacing of sleepers, types of sleepers, Rails: types, requirements for an ideal rail section, rail manufacture, rail wear, defects in rails and rail flaw detection. Creep: causes, effects of creep, measurement trough, cast iron, concrete etc.

#### UNIT-III

Geometric Design of Track; Necessity of Geometric design, design of track, curves and super elevation, transition curve, reverse curve, extra clearance of curves, widening of gauge on curves, vertical curves, cutting rails on curves, check rails on curves.

#### UNIT-IV

Sub grade Formation and Ballast; Slope of formation, execution of earthwork in embankments and cuttings, blanketing Material, Failure of railway embankment, site investigations. Ballast: functions, types, sizes of ballast, requirement of good ballast, design of ballast section, collection and transportation of ballast, methods of measurement, laboratory tests for physical properties of ballast. Track dt.

#### UNIT-V

Points and Crossings, Signaling and Interlocking: Important terms, Crossings, number and angle of crossing, reconditioning of worn out crossings, Switches, turnouts, layout of turnout, trends in turnout design on Indian Railways, inspection and maintenance of points and crossings. Level crossing: Classification, types, dimensions, accidents and remedial measures, maintenance and inspection. Signaling and interlocking: Objectives, types, signaling systems, systems for controlling train movement, interlocking, modern signaling installations.

#### Suggested Reading

1. Chandra, S. and Agarwal.M.M. "Railway Engineering". Oxford University Press, New Delhi, 2007.
2. Rangwala, K. S. "Principles of Railway Engineering". Charotar publishing House, India, 1991
3. Mundry J.S. "Railway Track Engineering". McGraw Hill Education (India) Private Limited, 2009.
4. Clifford F. Bonnett.. "Practical Railway Engineering" (2nd Edition), Imperial College Press, 2005.

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**B. Tech. (CE) VII SEMESTER**  
**PE4109 CE Ground Water Management**  
**(Professional Elective Course)**

Course code	PE4109 CE				
Category	Professional Elective Course				
Course title	Ground Water Management				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

**UNIT – I**

**Introduction:** Ground water in hydrologic cycle, Distribution of subsurface water, ground water potential in India and A.P, occurrence of Ground water in hydro geologic formations, components of groundwater studies, Darcy's law and its validity. Geophysical methods in groundwater Exploration: surface geophysical methods; Electrical resistivity method, seismic method, magnetic method, determination of aquifer thickness.

**UNIT – II**

**Governing Equations of Groundwater Flow in Aquifers:** 3-D Ground water flow equations in Cartesian and polar coordinates. Equations for steady radial flow into a well in case of confined and unconfined aquifers, Equations for effect of uniform recharge in a fully penetrating unconfined aquifer, well flow near aquifer boundaries. Equations for unsteady radial flow into a well in case of confined aquifer, determination of S and T by Theis's graphical method, Cooper- Jacob's and Chow's method.

**UNIT – III**

**Sources and Types of Groundwater Contamination:** Introduction underground storage tanks, landfills, surface impoundments, waste disposal of injection wells, radioactive contaminants, classification of organic compounds, inorganic compounds in ground water. Mechanism of salt water intrusion, Ghyben-Herzberg relation, slope and shape of the interface, prevention and control of seawater intrusion, case studies involving sea water intrusion.

**UNIT – IV**

**Contaminant Transport:** Introduction, advection process, diffusion and dispersion process, mass transport equation governing flow and transport equations, analytical methods, tests for dispersivity.  
**Non-Aqueous Phase Liquids (NAPL'S):** Types general processes transport; fate of NAPL'S in subsurface.

**UNIT – V**

**Models in Groundwater Analysis:** Major applications of ground water models, sand models, viscous fluid models, membrane models, thermal models, Electric-Analog models, numerical modeling of ground water systems.

***Suggested Readings:***

1. Rastogi, A.K. (2007). *Numerical Groundwater Hydrology*. Penram International Publishing (India) Pvt Ltd.
2. Ven-Te-Chow. (1964). *Hand Book of Applied Hydrology*. McGraw Hill Company, New York.
3. Todd, D.K. (1980). *Groundwater Hydrology*. John Wiley and Sons, New York.
4. Karanth, K. R. (1987). *Groundwater Assessment, Development and Management*. Tata McGraw-Hill publishing company New Delhi.
5. Raghunath H.M (1982). *Ground Water*. Wiley Eastern Ltd, New Delhi

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**B. Tech. (CE) VII SEMESTER**

**PE4110 CE Intelligent Transportation System**  
**(Professional Elective Course)**

Course code	PE4110 CE				
Category	Professional Elective Course				
Course title	Intelligent Transportation System				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

**UNIT – I**

**Fundamentals of Intelligent Transportation System (ITS):** Basics of ITS s, The historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS.

**UNIT – II**

**Data Requirements for ITS:** Importance of telecommunications in the ITS system. Information Management, Traffic management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques - Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, data collection using videos.

**UNIT – III**

**Functional Areas of ITS:** Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems(AVCS), Advanced Public Transportation System (APTS), Advanced Rural Transportation Systems(ARTS). ITS User Needs and Services – Travel and Traffic Management, Public Transportation management, Electronic Payment, Commercial Vehicle Operations, Emergency management, Advances Vehicle safety systems, information Management.

**UNIT – IV**

**ITS Architecture:** Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and Safety, and ITS Security ITS as a technology deployment program, research, development and business models/modules, ITS Planning.

**UNIT – V**

**ITS Applications:** Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road –pricing; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation in situations Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the world – Overviews of ITS implementation in developed countries, IRS in developing countries.

***Suggested Readings:***

1. Joseph, S.S. (2008). "*Perspectives on Intelligent Transportation Systems*", Springer publishers, USA.
2. Chowdhury, M. A., Sadek, A. and Boston, M.A. (2003). "*Fundamentals of Intelligent Transportation Systems Planning*", Artech House, -USA.
3. Kan Paul and Chen Jhon Miles (2007). "*Intelligent Transportation Systems*", Hand Book 2000: Recommendations for World Road Association (PIARC).
4. USDT. (2007), "*National ITS Architecture Documentation*", U.S. Department of Transportation, USA

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**B. Tech. (CE) VII SEMESTER**  
**OE4111 EC Optimization Techniques**  
**Open Elective**

Course code	OE4111 EC				
Category	Open Elective				
Course title	Optimization Techniques				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	2	External Marks = 70

**Unit-I**

**Introduction:** Statement of an optimization problem, Classification of optimization problems, Overview of various optimization Techniques, Properties of vectors, norms, positive semi-definite matrices.

**Unit-II**

**Classical optimization techniques:** Single variable optimization, Multivariable optimization, Convexity and concavity of functions of one and two variables, convex optimization problems, the simplex optimization technique, Test Functions.

**Unit-III**

**Unconstrained optimization:** General properties of minimization algorithms, Line search, the gradient method, Newton's method, least square Algorithm. **Constrained optimization:** Active constraints versus inactive constraints, transformations

**Unit-IV**

**Genetic algorithm (GA):** Fundamentals of Genetic algorithm, History, Basic concepts, working principle, Applications of GA.

**Unit-V**

**Swarm intelligence:** Basic particle swarm optimization, initialization techniques, Theoretical investigations and parameter selection, Design of PSO algorithm using computational statistics, Application of PSO.

**Suggested Readings:**

1. Richard W Daniels, An Introduction to Numerical Methods and Optimization Techniques, Elsevier North Holland Inc,
2. S Rajasekharan, G.A Vijaya Lakshmi Pai, Neural Networks, Fuzzy logic, and Genetic algorithms, Synthesis and Applications, Prentice hall of India, 2007
3. Rao, S.S., "Engineering Optimization: Theory and Practice", John Wiley & Sons, Inc., 2009
4. Taha, H.A., "Operations Research, Pearson Education India", New Delhi, India, 2008.
5. Randy L. Haupt and Sue Ellen Haupt, "Practical genetic algorithms" second edition, a John Wiley & sons, inc., publication -2004.

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**B. Tech. (CE) VII SEMESTER**  
**OE4112EC Fundamentals of IOT**  
**(Open Elective Course)**

Course code	OE4112 EC				
Category	Open Elective Course				
Course title	Fundamentals of IOT				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	2	External Marks = 70

### UNIT- I

**Introduction to Internet of Things:** IoT vision, Strategic research and innovation directions, IOT Applications, Related future technologies, Infrastructure, Networks and communications, Processes, Data Management, Security, Device level energy issues.

### UNIT- II

**Internet Principles and communication technology:** Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source.

### UNIT- III

**Prototyping for IoT:** Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi.

### UNIT- IV

**Cloud computing and Data Analytics:** Introduction to Cloud storage models -SAAS, PAAS, and IAAS. Communication APIs, Amazon web services for IOT.

### UNIT- V

**IoT Product Manufacturing - From prototype to reality:** Business model for IoT product manufacturing, Business models canvas, Funding an IoT Startup.

***Suggested Readings:***

1. “*Internet of Things*” - Converging Technologies for smart environments and Integrated Ecosystems, River Publishers.
1. Adrian McEwen, Hakim Cassimally, “*Designing the Internet of Things*”, Wiley India Publishers
2. Daneil W lewies, “*Fundamentals of embedded software: where C meets assembly*”, Pearson.
3. ArshdeepBahga, “*Internet of things -A hands on Approach*” Universities press.



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**B. Tech. (CE) VII SEMISTER**  
**OE4113ME Basic Material Science and Engineering**  
**(Open Elective Course)**

Course code	OE4113 ME				
Category	Open Elective Course				
Course title	Basic Material Science and Engineering				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	2	External Marks = 70

**UNIT-I**

**Introduction:** Importance of Material Science, Level of structures, structure property relationship, Defects in materials,

**UNIT-II**

**The Iron carbon systems:** Definition of phase, phase diagram, Iron Carbon Phase diagram, Concept of Steel and Cast Iron. Phases in Fe-C system.

**UNIT-III**

**Steels:** Effect of alloying elements on steel. Properties of plain carbon steels, stainless steel and tool steels

**UNIT-IV**

**Cast irons:** Properties and applications of Ductile irons, Malleable irons, Grey Cast Iron, Spheroidal Cast iron

**UNIT-V**

**Non Ferrous Metals:** Aluminum Alloys limited to designation and properties, Copper alloys limited to basic brasses and bronzes their properties

***Suggested Readings:***

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997
3. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA, 2006

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**B. Tech. (CE) VII SEMESTER**  
**OE4114HSIPR and Patenting**  
**(Open Elective Course)**

Course code	OE4114HS				
Category	Open Elective Course				
Course title	IPR and Patenting				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	2	External Marks = 70

**UNIT-I**

Introduction to intellectual property Act and Law-the evolutionary past-the IPR tool kit- legal tasks in intellectual property law-ethical obligations in Para legal tasks in intellectual property law

**UNIT-II**

Introduction to trade mark - Trade mark registration process-Post registration procedures- Trademark maintenance - transfer of rights-inter party's proceeding - Infringement-Dilution ownership of trade mark-likelihood of confusion - trademark claims- trademark litigations

**UNIT-III**

Introduction to copy rights- principles of copyright - subjects matter of copy right- rights afforded by copyright law- copyright ownership transfer and duration - right to prepare derivative works right of distribution- right to perform the work publicity- copyright formalities and registrations

**UNIT-IV**

Introduction to patent law- Rights and limitations- Rights under patent law- patent requirements ownership - transfer- patent application process- patent infringement- patent litigation

**UNIT-V**

Introduction to transactional law- creating wealth and managing risk - employment relationship in the Internet and technologic al sector-contact for internet and technological sector

***Suggested Readings:***

1. KompalBansal and PraishitBansal, "Fundamentals of IPR for Engineers", 1st Edition, BS Publications, 2012.
2. Prabhuddha Ganguli, "Intellectual Property Rights", 1st Edition, TMH, 2012.
3. R Radha Krishnan & S Balasubramanian, "Intellectual Property Rights", 1st Edition, Excel Books, 2012.
4. M Ashok Kumar & mohd Iqbal Ali, "Intellectual Property Rights", 2nd Edition, Serial publications, 2011.

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**B. Tech. (CE) VII SEMISTER**  
**PW4115CEPROJECT WORK PART A**  
**(Project Work )**

Course code	PW4115CE				
Category	Project Work				
Course title	PROJECT WORK PART A				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	4	2	External Marks = 50

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide. Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

**Each group will be required to:**

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

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**B. Tech. (CE) VII SEMISTER**  
**PC4116CE Computer Aided Building Lab**  
**(Professional Core Course)**

Course code	PC4116CE				
Category	Professional Core Course				
Course title	Computer Aided Building Lab				
Scheme and Credits	L	T	P	Credits	Internal marks = 25
	-	-	3	1.5	External Marks = 50

1. Types of Buildings, Functional Planning, Building by-laws and Regulations, Orientation of Buildings.
2. Principles of Planning – Planning of space.
3. Development of plan, Section and Elevation.
4. Planning of Residential Buildings-Minimum requirements.
5. Planning of Public Buildings – Minimum space requirements for Bank, Post Office, School, and Dispensary etc.
6. Various types of doors, windows and ventilators.
7. Details of a Staircase.
8. Pitched Roof Construction – King Post Truss and Queen Post Truss.

**MANUAL & COMPUTER AIDED DRAWINGS**

1. Conventional signs.
2. Development of plan from line diagram.
3. Plan, Section and Elevation of Residential Building with Unrestricted Plinth Area.
4. Plan, Section and Elevation of Residential Building with Restricted Plinth Area.
5. Drawing of various types of Doors, Windows and Ventilators.
6. Plan of School Building and Dispensary.
7. Plan of Bank and Post Office.
8. Plan of an Industrial Structure.
9. Section and Elevation of a Staircase
10. Plan of Dream House.
11. Plan of Duplex Building.
12. Plan of a Residential Building with split level.

**Suggested Readings**

1. National Building Code of India, 1983 – Bureau of Indian Standards, New Delhi.
2. Shah, Kale and Patki, Building Drawing, Tata McGraw hill Book Company Limited, New Delhi.
3. Y.N.RajaRao, Y. Subramanyam, *Planning and Designing of Residential Buildings*, Standard Publishers Distributors, New Delhi.