

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering
(Applicable from the academic session 2018-2019)

Semester VI [Third year]

CE(PC)601	Construction Engineering & Management	2L + 1T	3 Credits
Module 1	Basics of Construction- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution;		2L
Module 2	Construction project planning- Stages of project planning: pre-tender planning, preconstruction planning, detailed construction planning, role of client and contractor, level of detail.Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks.PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.		10L
Module 3	Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.		6L
Module 4	Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities		4L
Module 5	Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction		6L
Module 6	Project Monitoring & Control- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.		8L
Module 7	Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.		4L
Module 8	Construction Costs: Make-up of construction costs; Classification of costs, time-cost trade-off in construction projects, compression and decompression.		2L
	1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007. 2. National Building Code, Bureau of Indian Standards, New Delhi, 2017. 3. Chudley, R., Construction Technology, ELBS Publishers, 2007. 4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011 5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006 6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015 7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.		

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CE(PC)602	Engineering Economics, Estimation & Costing	2L + 1T	3 Credits
Module 1:	Basic Principles and Methodology of Economics. Demand/Supply – elasticity –Government Policies and Application. Theory of the Firm and Market Structure. Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes		3L
Module 2:	Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.		2L
Module 3	Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control – Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.		3L
Module 4	Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.		4L
Module 5	<i>Estimation</i> / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying		7L
Module 6	Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.		3L
Module 7	Rate analysis-Purpose, importance and necessity of the same, factors affecting, taskwork, daily output from different equipment/ productivity.		3L
Module 8	Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management		6L
Module 9	Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.		2L
Reference	1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia 2. V. Mote, S. Paul, G. Gupta (2004), Managerial Economics, Tata McGraw Hill 3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya 4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers 5. M Chakravarty, Estimating, Costing Specifications & Valuation 6. Joy P K, Handbook of Construction Management, Macmillan 7. B.S. Patil, Building & Engineering Contracts 8. Relevant Indian Standard Specifications. 9. World Bank Approved Contract Documents. 10. FIDIC Contract Conditions. 11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration 12. Typical PWD Rate Analysis documents. 13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, 2016 14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016		

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CE(PE)601A	Geometric Design of Highways	2L + 0T	2 Credits
	Introduction: Classification of rural highways and urban roads.Objectives and requirements of highway geometric design; Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors; Design Elements: Sight distances,Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends,design of expressways, IRC standards and guidelines for design problems; Cross Section Elements:Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types,cross slope, skid resistance, unevenness; Design Considerations: Design considerations for rural and urban arterials, freeways, and other rural and urban roads; Design Of Intersections: Characteristics and design considerations of at-grade intersections;; Rotary intersections; Grade separations and interchanges -; Design of Parking lots		32L

CE(PE)601B	Transport of Water and Wastewater	2L + 0T	2 Credits
	Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation. Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety. Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance		32L

CE(PE)601C	Structural Analysis-I	2L + 0T	2 Credits
	Direct stiffness method of structural analysis; fundamentals and algorithms; numerical analysis of plane trusses, grids and frames; virtual work and energy principles; introduction to the finite element method for plane stress and plane strain.		32L

CE(PE)601D	Foundation Engineering	2L + 0T	2 Credits
Module 1	Retaining wall & sheet pile structures: Proportions of retaining walls, stability checks, cantilever and anchored sheet piles, free earth and fixed earth method		6L
Module 2	Site investigation & soil exploration: Planning of sub-surface exploration, methods, sampling, samples, In-situ tests: SPT, SCPT, DCPT, Plate load test. Geo-physical exploration: Seismic refraction and electrical resistivity method. Preparation of bore-log and soil investigation report		6L
Module 3	Shallow foundations : Terzaghi's bearing capacity theory, effect of depth of embedment, water table, eccentricity of load, foundation shape on bearing capacity, Bearing capacity as per IS 6403		6L
Module 4	Settlement analysis of shallow foundation: Immediate and consolidation settlement, correction for rigidity and dimensional effects, settlement in various types of soil, IS-1904 and 8009 recommendations		4L
Module 5	Deep foundations: Pile: Types, load transfer mechanism, Determination of load carrying capacities of piles by static and Dynamic formulae, Recommendations of IS 2911, Pile group: Group efficiency, Negative skin friction, pile load test		6L
Module 6	Foundations on Problematic soils: Problems and Remedies		4L
Reference	1. Principles of Foundation Engineering, B.M Das, Thomson Brook 2. Foundation Analysis and Design, J. E. Bowles, McGraw-Hill Book Company 3. Foundation Engineering by B.C.Chattopadhyay and J.Maity, PHI learning Pvt. Ltd 4. Foundation Engineering N. Som & S. C. Das 5. Codes: Bureau of Indian Standard IS -1904, 6403, 8009, 2950, 2911		

CE(PE)602A	Pavement Design	2L + 0T	2 Credits
	Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements.Stresses and Deflections in Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads.		32L

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	<p>Pavement behaviour under transient traffic loads. Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.</p> <p>Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC</p>	
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CE(PE)602B	Air and Noise Pollution and Control	2L + 0T	2 Credits
	<p>Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect.</p> <p>Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles. Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality.</p> <p>Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods</p>		32L

CE(PE)602C	Structural Analysis-II	2L + 0T	2 Credits
	<p>Analysis of building frames; Kani's, moment distribution and other methods and Approximate methods; Stiffness matrix method; Application to simple problems of beams and frames; Flexibility matrix method; Application to simple problems of beams and frames; Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffening girders.</p>		34L

CE(PE)602D	Soil Mechanics-II	2L + 0T	2 Credits
Module 1	Earth pressure; Earth pressure theories: Plastic equilibrium of soil, Earth pressure at rest, Active & passive earth pressure, Rankine's & Coulomb's earth pressure theories, wedge method of analysis, estimation of earth pressure by graphical construction (Culmann Method		8L
Module 2	Retaining walls structures, Gravity cantilever and counterfort retaining walls: Stability checks and design. Sheet Pile Structures: Cantilever sheet piling, Anchored sheet piling: Free and fixed earth support methods of Analysis, Analysis of cuts & excavations		10L
Module 3	Stability of slopes: Stability Analysis of Slope: Effective and total stress approach, shape of slip surface, methods of slices, graphic methods, location of critical slip circle, wedge analysis method		8L
Module 4	Soil Anchors: Inclusions and Installation Techniques, Application Criteria: Advantages and Limitations: Instrumentation		6L
Reference	<ol style="list-style-type: none"> 1. Principles of Soil Mechanics, R F Scott, Addison & Wesley 2. Principles of Geotechnical Engineering, Braja M. Das, Cengage Learning 3. Soil Behaviour and Critical State Soil Mechanics, D.M. Wood, University of Glasgow 4. Soil Mechanics by Craig R.F., Chapman & Hall 		

CE(PE)603A	Concrete Technology	2L + 1T	3 Credits
	<p>Concrete; Properties of ingredients, tests, Production of concrete, mixing, compaction curing, Properties of fresh concrete; Defects in Concrete, Concrete additives.; Behavior of concrete in tension and compression, shear and bond, Influence of various factors on test results, Time dependent behavior of concrete -creep, shrinkage and fatigue; Concrete mix design; Proportioning of concrete mixes, basic considerations, cost specifications, factors in the choice of mix proportion, different method of mix design. Quality control, Behavior of</p>		42L

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	concrete in extreme environment; temperature problem in concreting, hot weather, cold weather and under water conditions, Resistance to freezing, sulphate and acid attack, efflorescence, fire resistance; Inspection and testing of concrete- Concrete cracking, types of cracks, causes and remedies Non-destructive tests on concrete; Chemical tests on cement and aggregates; Special concrete; types and specifications, Fibre reinforced and steel Fibre reinforced concrete, Polymer concrete, Use of admixtures; Deterioration of concrete and its prevention Repair and rehabilitation.	
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CE(PE)603B	Soil Mechanics-I	2L + 1T	3 Credits
Module 1	Composition and structure of soil; Fundamental of Soil Structure, Clay Mineralogy		6L
Module 2	Water flow and hydraulic properties; Darcy's law, Permeability of soils, Laboratory and field determination, pumping in and pumping out tests. Flow nets -properties and uses. Confined and unconfined flow of water. Flow through earth dam, under hydraulic structures and foundation structures		8L
Module 3	Stress in soil; Stress due to point loads, Stress beneath Line, strip & uniformly loaded circular area & rectangular area, pressure bulbs, Newmark's charts-Use for determination of stress due to arbitrarily loaded areas		6L
Module 4	Compaction and compressibility of soils; One and three dimensional consolidation theories and applications, consolidation characteristics, Immediate and consolidation settlement, settlement analysis		6L
Module 5	Shear strength of soils: Shear strength parameters of cohesion less and saturated cohesive soils, Skempton's Pore pressure coefficients, Basics of unsaturated soils, Experimental measurements		6L
Reference	1. Principles of Soil Mechanics, R F Scott, Addison & Wesley 2. Principles of Geotechnical Engineering, Braja M. Das, Cengage Learning 3. Soil Behaviour and Critical State Soil Mechanics, D.M. Wood, University of Glasgow 4. Soil Mechanics by Craig R.F., Chapman & Hall		

CE(PE)603C	Solid and Hazardous Waste Management	2L + 1T	3 Credits
	Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal. Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Groundwater contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.		40L

CE(PE)603D	Geographic Information Systems and Science	2L + 1T	3 Credits
	Basic Concepts of GIS : Definition, philosophy & Historical Evolution of GIS; Spatial vs Non-Spatial Data; Components of GIS; Spatial Data Models – Raster and Vector; Data Structure and File Formats; Concepts of RDBMS and Geodatabase. Data Entry and Editing: Sources of Spatial Data (Raster and Vector); Various data input techniques; Datum and Projection; Types of Coordinate Systems; Affine Transformation Spatial Data Analysis-I: Raster Data Analysis – Local, Focal, Zonal and Global Analysis; Vector Data Analysis – Proximity and Overlay Analysis Spatial Data Analysis-II: Spatial Interpolation Techniques; Network Analysis; DEM, DTM and DSM; Difference between 2D, 2.5D, 3D and 4D GIS; Watershed Analysis. GPS and GNSS: Concept of GPS; Satellite Constellations; NAVSTAR GPS Signals; Geopositioning – Concepts, Pseudo Range Measurement, Phase Difference Measurement, Sources of GNSS Errors; Augmentation Systems of IRNSS, GAGAN, WAAS and LAAS. References: 1. Burrough, Peter A. and Rachael McDonnell (1998), „Principles of Geographical Information Systems“ Oxford University Press, New York. 2. George Joseph & C.Jeganathan (2018). Fundamentals of Remote Sensing 3rd edition, Universities Press, India. 3. C.P.Lo and Albert K.W.Yeung (2006). Concepts and Techniques of Geographic Information		40L

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	Systems. Prentice Hall of India, New Delhi. 4. Kang-tsung Chang (2007). Introduction to Geographic Information Systems, Tata McGraw Hill, New Delhi. 5. Satheesh Gopi (2005). Global Positioning System: Principles and Applications. McGraw Hill Publishers. 6. N. Madhu, R. Sathikumar, Satheesh Gopi (2006). Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India Publisher	
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CE(PE)604A	Pavement Materials	2L + 0T	2 Credits
	Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties and tests on road aggregates for flexible and rigid pavements. Bitumen: Origin, preparation, properties and tests, constitution of bituminous road binders; requirements; Criterion for selection of different binders. Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests. Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. bituminous mix design methods and specifications. Weathering and Durability of Bituminous Materials and Mixes. Performance based Bitumen Specifications; Superpave mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials.		34L

CE(PE)604B	Design of Concrete Structures-I	2L + 0T	2 Credits
	Study of the strength, behavior, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. Analysis and design of sections in bending – working stress and limit state method, Rectangular and T-sections, Beams with reinforcement in compression, One-way slab. Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept, Development length of bars; Design of sections in torsion. Design of two-way slabs; Design of flat slab – direct method; Circular slab; Slab type staircase, Placement of reinforcement in slabs; Voided slab. Design of compression members, Short column, Columns with uni-axial and bi-axial bending; Long columns, use of design charts. Design of foundation; Wall footing, Isolated and combined footing for columns. All designs to be as per the most recent BIS standards as applicable		36L

CE(PE)604C	Environmental Impact Assessment and Life Cycle Analyses	2L + 0T	2 Credits
	Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.		30L

CE(OE)601A	Soft Skills and Interpersonal Communication	1L + 1T	2 Credits
Module 1	Self-Introduction	2L	
Module 2	Negotiation Skills & Role Play	4L	
Module 3	J-a-M Session	3L	
Module 4	Building Vocabulary Power through Reading	4L	
Module 5	Group Discussion and Case Study	4L	
Module 6	Writing Skills: Letters, Minutes of Meeting	3L	
Module 7	Technical Report Writing: Concept & Structure	3L	
Module 8	Research Writing: Concept & Structural Framework	3L	
Module 9	Power Point Presentation: Project Presentation	4L	
Module 10	Interviews	5L	

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CE(OE)601B	Introduction to Philosophical Thoughts	1L + 1T	2 Credits
Module 1	Introduction to Indian Philosophy: Brief discussion on Veda and Upanishads; Origin of Indian Philosophy		1L
Module 2	Charvaka Philosophy: Epistemology; Metaphysics		3L
Module 3	Samkhya Philosophy: Metaphysics; Theory of Causation. --Prakṛti, Purusa, Evolution; Epistemology		6L
Module 4	Yoga Philosophy: Organization of the YogaSutras; Psychology of Yoga -- Stages of Citta, Forms of Citta, Modifications of Citta, Kinds of Klesas; The Eight-Fold Yoga; God and Liberation		4L
Module 5	Nyaya Philosophy : Epistemology -- Perception (Pratyaksa), Inference (Anumāna), Comparison (Upamāna), Testimony (Sabda); Theory of Causation (Asatkāryavāda); Self and Liberation; The Concept of God		9L
Module 6	Mimamsa Philosophy: Epistemology -- Validity of Knowledge; Sources of Valid Knowledge (Pramāna) – Perception, Inference, Comparison, Verbal Testimony, Postulation (Arthapāti), Non Apprehension (Anupalabdhi); Theories of Error (Khyativāda) – Akhyativāda, AnirvacaniyaKhyativāda, Viparitakhyativāda; Metaphysics -- Theory of Causation; Nature of Self; God and Liberation		5L
Module 7	Vaisesika Philosophy: Metaphysics and the Categories -- Substance (Dravya), Quality (Guṇa), Action (Karma), Generality (Sāmānya), Particularity (Vaiśeṣa), Inherence (Samavāya), Non-existence (Abhāva); Epistemology; The Concept of God; Bondage and Liberation		6L
Module 8	Buddhist Philosophy: Epistemology -- Dependent Origination; Four Noble Truths; Eight Fold Paths; Ethics; Karma and Rebirth; Liberation		5L
Module 9	Jaina Philosophy: Syādvāda; Anekāntavāda; Ethics; Karma and Liberation		3L

LABORATORY

CE(PC)691	Engineering Economics, Estimation & Costing	0L + 4L	2 Credits
	<ol style="list-style-type: none"> 1. Deriving an approximate estimate for a multistoried building by approximate methods. 2. Detailed estimate for the following with the required material survey for the same. <ol style="list-style-type: none"> a. Ground plus three storied RCC Framed structure building with blockwork walls b. bridge with minimum 2 spans c. factory building d. road work e. cross drainage work f. Ground plus three storied building with load-bearing walls g. Cost of finishes, MEP works for (f) above 3. Preparation of valuation report in standard Government form. 4. Assignments on rate analysis, specifications and simple estimates. 5. Detailed estimate of minor structure. 6. Preparation of Bar bending schedule. 		