IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme & Syllabus

Civil Engineering Department

(U.G.NBA Accredited up to June 2023)

Bachelor of Technology (B.Tech.)
Honors Certification in Civil Engineering Department

(To be offered to students of Civil Engineering Department)

S.No.	Semester	Subject Code	Subject Name	Contact Hours perweek			Total Credits
				L	T	P	
1	V		Advanced Mechanics of Materials / Advanced Transportation Engineering	3	-	2	4
2	VI		Instrumentation Engineering / Advance Surveying	3	-	2	4
3	VII		Ground Water Engineering / Advanced Irrigation Engineering	3	2	-	4
4	VIII		Operation Research / Design of Masonry Structures	3	2	-	4
Total				**12**	**4**	**4**	**16**
Total Academic Engagement and Credits				**20**			**16**

* L : Lecture, T: Tutorial, P:Practical

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Honors Subject Offered by Civil Department

	Advanced Mechanics of Materials	**3L : 0T : 2P (5 hrs.)**	**4 credits**

Course Objective:

The objective of this course is to understand properties of material and their failure mechanism

Course Contents: (40 hrs.)

Module 1: **(08 hrs)**

Mathematical Preliminaries: Introduction to tensor algebra: symmetric and skew-symmetric tensor, summation convention, eigenvalue and eigenvector of tensor, spectral theorem, polar decomposition theorem, product of tensor, principal invariants of tensor, coordinate transformation of tensor, Tensor calculus: gradient, divergence, curl, differentiation of scalar function of a tensor.

Module 2: **(08 hrs)**

Analysis of Stress and Strain: Definition and notation of stress, Cauchy stress tensor, equations of equilibrium, principal stresses and stress invariants, stress deviator tensor, octahedral stress components, General deformations, small deformation theory, strain transformation, principal strains, spherical and deviatoric strains, Strain-displacement relations, strain compatibility, stress and strain in curvilinear, cylindrical, and spherical coordinates, fundamental equations of plasticity.

Module 3: **(08 hrs)**

Problem Formulation and Solution Strategies: Field equations, boundary conditions, stress and displacement formulation, Beltrami-Michell compatibility equations, Lame-Navier's equations, principle of superposition, uniqueness theorem, Saint-Venant's principle, Brief descriptions about general solution strategies - direct, inverse, semi-inverse, analytical, approximate, and numerical methods.

Module 4: **(08 hrs)**

Two-Dimensional Problems: Plane stress and plane strain problems, generalized plane stress, Antiplane strain, Airy stress function, polar coordinate formulation and solutions, Cartesian coordinate solutions using polynomials and Fourier series method.

Module 5: **(08 hrs)**

Applications: Torsion of Noncircular Shafts: Warping and Prandtl stress function, Torsion analysis of circular, elliptical, and rectangular cylinder using Warping and Prandtl function, Membrane analogy, Photo elasticity, Plates and shells – Fundamental equations, Kirchhoff's theory, axisymmetric bending of circular plates, membrane theory of shells of revolutions.

Course Outcomes

CO1 Understand the concept of tensor.

CO2 Analyse advanced concept of stress and strain in structural problems.

CO3 Apply the concept of different elastic functions to solve complex problems.

CO4 Evaluate the influence of various geometric and loading parameters in plane stress and plane strain problems.

CO5 Implement advanced concept of solid mechanics in torsion, plates and shells**..**

List of Text / Reference Books

1. Continuum Mechanics, A.J.M Spencer, Dover Publications, INC
2. Advanced Mechanics of Materials by H. Ford and J. M. Alexander
3. The Linearized Theory of Elasticity, W. S. Slaughter, Springer Science+Business Media, LLC
4. Elasticity, Theory, Applications, and Numerics by Martin H. Sadd
5. Theory of Elasticity by Stephen Timoshenko and , J. N. Goodier
6 Advanced Mechanics of Solids, Otto T. Bruhns, Springer publications.

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	Advanced Transportation Engineering	**3L : 0T : 2P (5 hrs.)**	**4 credits**

Course Objective:

To provide knowledge of various concepts related advanced transportation engineering.

Course Contents: (40 hrs.)

Module 1: **(08 hrs)**

Introduction to Traffic Engineering: Properties of Traffic Engineering Elements, Road Vehicle performance, Traffic Studies Volume studies, Speed studies, Origin and destination studies and parking studies, Capacity and Level-of-service analysis.

Module 2: **(08 hrs)**

Traffic Flow Theory: Introduction to traffic flow theory, Uninterrupted traffic Flow Theory: Fundamentals of Traffic flow theory, Uninterrupted Traffic flow including Macroscopic and Microscopic Traffic flow models, Interrupted traffic Flow Theory: Fundamentals of Interrupted Traffic Flow, Shockwave Analysis, Car following theory, Queuing Theory, Vehicle arrival: Gap and Gap acceptance

Module 3: **(08 hrs)**

Introduction to Transportation Planning: Importance of transportation, transportation planning methodology, hierarchical levels of planning and its relation to rural, urban areas. Long range planning, Passenger and goods transportation, General concept and process of transport planning, Land-use transport interactions, Socio-economic characteristics of Land use

Module 4: **(08 hrs)**

Transportation Systems: Multi modal transportation system; Characteristics of Mass Transit systems including technical, demand operational and economic problems, fixed Track Facility, Mass Rapid Transit System, Elevated, Surface and Underground construction, Express Bus System, integrated Operating Characteristics of Terminal and Transfer facilities.

Module 5: **(08 hrs)**

Planning Methodology and Systems Analysis: -trip generation techniques, Category analysis, multiple regression techniques, Modal split analysis, Trip distribution techniques, Growth Factor model, Gravity models, Opportunity models and multiple regression models, Traffic assignment methods, Minimum Path tree-All or nothing assignment and capacity restraint techniques, analysis and evaluation techniques.

Course Outcomes:

CO1: Use the Traffic survey analysis for management of traffic and for designing new road infrastructure.

CO2: Applications of Traffic flow theories in solving congestion problems.

CO3: Introduction to transportation planning concepts.

CO4: Have an in-depth knowledge of various systems of transportation.

CO5: Introduction to the transportation planning process.

List of Text / Reference Books

1. Kadiyali, L. R., Traffic Engineering and Transport Planning,. Khanna Publishers.
2. O'Flaherty C A, "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA.
3. Chakroborty Partha and Animesh Das, Principles of Transportation Engineering, Prentice hall.
4. Highway Engg.-Khanna S.K. and Justo C. E. G. New Chand Publication.
5. Transportation Engineering and Planning, by C. S. Papacostas and P. D. Prevedouros, Prentice Hall of India Private Limited.

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	Instrumentation Engineering	**3L : 0T : 2P (5 hrs.)**	**4 credits**

Course Objective:

To expose the students to various measurement techniques used for the measurement of temperature, flow, pressure and level in process industries.

Course Contents: (46 hrs.)

Module 1 **(08 hrs.)**

Temperature Measurement: Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and its measuring circuits, Radiation pyrometers and thermal imaging.

Module 2 **(08 hrs.)**

Pressure Measurement: Introduction, definition and units, Mechanical, Electro-mechanical pressure measuring instruments. Low pressure measurement, Transmitter definition types, I/P and P/I Converters.

Module 3 **(10 hrs.)**

Level measurement: Introduction, Mechanical and electrical methods of level measurement.

Module 4 **(10 hrs.)**

Flow Measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters.

Module 5 **(10 hrs.)**

Flow Measurement: Hot wire anemometer, laser Doppler anemometer, ultrasonic, vortex and cross correlation flow meters, and measurement of mass flow rate.

Course Outcomes:

CO1: Familiar with the different temperature measurement techniques used in process industries.

CO2: Familiar with various flow instrumentation used in industrial flow measurement.

CO3: Able to understand the working principle of different pressure transmitters and level sensors used in industries.

CO4: Able to identify or choose temperature, flow

CO5: Able to identify pressure and level measuring device for specific process measurement.

Reference Books:

1. Ernest.O.Doebelin and Dhanesh.N.Manik, Doebelin's Measurement Systems, McGraw Hill Education, 6th Edition, 2011.
2. B.G.Liptak, Process Measurement and Analysis, 4th Edition, CRC Press, 2003.
3. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.
4. B.E.Noltingk, Instrumentation Reference Book, 2ndEdition, Butterworth Heinemann, 1995.
5. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, 5th Edition, McGraw Hill, Singapore, 1999.
6. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001
7. Spitzer D. W., Industrial Flow measurement, ISA press, 3rd Edition, 2005.
8. Tony.R.Kuphaldt, Lessons in Industrial Instrumentation, Version 2.02, April 2014.

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	Advance Surveying	3L : 0T : 2P (5 hrs.)	4 credits

Course Objective:

To make students aware with different advance surveying methodologies applied to carry out large scale survey works as modern instruments have largely changed the approach to survey works with the principles being same.

Course Contents: (40hrs.)

Module 1 **(08 hrs.)**

Tacheometric Surveying: Introduction, purpose, principle & use of tacheometry, Instrument used & stadia hairs & Fixed hair methods of tacheometry, Tacheometry constant & Problems Anallatic lens theory, subtense bar, Field work in tacheometry. Reduction of readings, errors and precisions. Difference between Theodolite & Tacheometer.

Module 2 **(08 hrs.)**

Field Astronomy: Introduction & Instruments & purpose, Astronomical terms, Time & conversion of time, Abbreviations, Determination of azimuth , Latitude and longitude & Examples of azimuth , Latitude and longitude.

Module 3 **(08 hrs.)**

Photogrammetric Surveying: Introduction, principle, uses Aerial camera, aerial photographs Definitions, scale of vertical and tilted photograph Ground coordinates, ground control, examples on scale, Displacements and errors, Examples on Displacement and errors, Procedure of aerial survey, Examples on flight planning, Photomaps and mosaics. Difference between Mosaic & Map, Stereoscopes, Parallax bar,Examples on Parallax bar.

Module 4 **(08 hrs.)**

Remote Sensing & Geographical Information System: Introduction, principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation, Digital image processing, Global positioning system,Types, Applications of GPS,Method of operation,System Segmentation Integration of remote sensing and GIS, applications in civil engineering.

Module 5 **(08 hrs.)**

Special Survey Instruments: Introduction, Electromagnetic Distance Measurement, Electronics Theodolite, Total station, Site square, PentaGraph, Autoset Level, Transit level, Special Compasses, Brunton Universal Pocket Transit, Mountain Compass Transit.

Course Outcomes:

CO1: On the successful completion of this course the students will get a diverse knowledge of surveying practices applied for real life problems.

CO2: The students will learn to work with various surveying equipments, like, Theodolite,Total station, etc. in order to apply the theoretical knowledge to carry out practical field work.

CO3: The knowledge of limits of accuracy will be obtained by making measurements with various surveying equipment employed in practice.

CO4: The students will learn Remote Sensing & Geographical Information System.

CO5: The students will learn to work with various Special Survey Instruments

Reference Books:

1.Duggal, S. K., Surveying Vol. I & II, Tata Mcgraw Hill, New Delhi

2. Subramanian, R., Surveying & Levelling, Oxford University Press, New Delhi

3. Punamia, B.C., Surveying Vol. I, II & III, Laxmi Publications

4. Kanetkar, T.P. and Kulkarni, S.V., Surveying and Levelling Vol. I & II, Pune Vidhyarthi Gruh

5. Arora, K.R., Surveying Vol. I, II & III, Standard Book House. New Delhi

6. Basak, N.N., Surveying and Levelling, Tata Mcgraw Hill, New Delhi

7. Agor, R., Surveying and Levelling, Khanna Publishers, New Delhi

8. Agor, R. Advanced Surveying, Khanna Publishers, New Delhi
9. Roy, S.K., Fundamentals of Surveying, Prentice Hall India, New Delhi
10. Remote Sensing and GIS by B Bhatia, Oxford University Press, New Delhi.
11. Remote sensing and Image interpretation by T.M Lillesand,. R.W Kiefer and J.W Chipman, 5th edition, John Wiley and Sons India
12. Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2002
13. Anji Reddy, M., Remote Sensing and Geographical Information Systems, B.S.Publications, Hyderabad, 2001

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	Ground Water Engineering	**3L : 2T : 0P (5 hrs.)**	**4 credits**

Course Objective:

The objective of this course is to fulfill the essential knowledge of ground water, hydrology of ground water, well irrigation, ground water (management, transport process) and ground water quality.

Course Contents: (50hrs.)

Module 1 **(10 hrs.)**

Ground Water: Confined and unconfined aquifers, aquifer properties, Ground water recharge-necessity and methods of improving ground water storage. Water logging-causes, effects and its prevention. Salt efflorescence causes and effects. Characteristic of ground water, Reclamation of water logged and salt affected lands. Role of groundwater in water resources system and their management,

Module 2 **(10 hrs.)**

Well Hydraulics: Hydraulics of wells under steady flow conditions, infiltration galleries. Types of wells, well construction, yield tests, specific capacity and specific yield, advantages and disadvantages of well irrigation.

Module 3 **(10 hrs.)**

Ground Water Management: Need for Management Model – Database for groundwater management –groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery.

Module 4 **(10 hrs.)**

Groundwater Transport Process: Hydrodynamic dispersion - occurrence of dispersion phenomena, coefficient of dispersion - Aquifer advection dispersion equation and parameters - initial and boundary conditions - method of solutions, solution of advection dispersion equation.

Module 5 **(10 hrs.)**

Ground water Survey and Water Quality: Geophysical survey of ground water - Surface Geophysical techniques- electric logging & radioactive logging Method. Ground water quality - Factors affecting ground water quality. Water quality requirements, Groundwater quality degradation, Reasons of groundwater quality degradation.

Course Outcomes:

CO 1. To understand the ground water properties, recharging, methods of improving ground water and reclamation of water logging and salt .

CO 2. To illustrate the hydraulics, construction and tests of well efflorescence.

CO3. To illustrate the mathematical model, management and conjunctive use.

CO 4. To realize the process of ground water transportation

Reference Books:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.
3. Engg. Hydrology by K. Subhramanya - Tata Mc Graw Hills Publ. Co.
4. Engg. Hydrology - J.NEMEC - Prentice Hall
5. Hydrology for Engineers Linsley, Kohler, Paulnus - Tata Mc.Graw Hill.
6. Engg. Hydrology by H.M. Raghunath

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	Advanced Irrigation Engineering	**3L : 2T : 0P (5 hrs.)**	**4 credits**

Course Objective:

The objective of this course is to fulfill the essential knowledge of ground water, hydrology of ground water, irrigation methods & technology, and soil-water-crop relationship

Course Contents: (40hrs.)

Module 1 **(08 hrs.)**

Development of Irrigation: Water Resources of India - Irrigation- Need, Advantages and Disadvantages, History of Irrigation development in India- National Water Policy- Inadequacy of Irrigation Management- Criteria for good Irrigation management, Irrigation development.

Module 2 **(08 hrs.)**

Irrigation water requirement: Irrigation, definition, necessity, advantages and disadvantages, types and methods. Water requirement of crops- Evapotranspiration and Consumptive use- Methods of estimating Evapotranspiration- Effective Rainfall- Irrigation Requirement. Duty of water, factors affecting duty and methods to improve duty, suitability of water for irrigation

Module 3 **(08 hrs.)**

Soil-Water-Crop relationship: Soils - types and their occurrence, suitability for irrigation purposes, wilting coefficient and field capacity, optimum water supply, consumptive use and its determination. Energy concept of Soil Water-Forces acting on Soil Water- Soil Water Potential concept- Soil Water retention- Soil Moisture Measurement. Crops and crop seasons, principal crops and their water requirement, crop ratio and crop rotation, intensity of irrigation.

Module 4 **(08 hrs.)**

Irrigation Methods & Design: Canal network and canal design- Surface irrigation methods- Types- Border irrigation, Furrow irrigation and Strip irrigation- Specifications, Hydraulics and Design. Sprinkler and Drip- History and development, Types, Components, Design and Layout, Performance Evaluation, Operation and Maintenance.

Module 5 **(08 hrs.)**

Advanced Irrigation Technology: Application of remote sensing & GIS in irrigation, remote sensing & GIS techniques for assessing irrigation performance, Estimation of irrigated area and cropping pattern, land and water productivity, modeling and mapping flood-prone zones.

Course Outcomes:

CO 1. To understand the necessity & management of irrigation, resources and national water policy of India.

CO 2. To illustrate the hydraulics, construction and tests of well.

CO3. To understand soil-water-crop relationship, crop seasons and crop water requirement.

CO 4. To illustrate irrigation methods, network and design of canal.

CO 5. To understand the surface geophysical techniques, survey and quality degradation of ground water.

Reference Books:

1. Irrigation & Water Power Engg. by Punmia & Pandey B.B.Lal
2. Engg. Hydrology by K. Subhramanya - Tata Mc Graw Hills Publ. Co.
3. Engg. Hydrology - J.NEMEC - Prentice Hall
4. Hydrology for Engineers Linsley, Kohler, Paulnus - Tata Mc.Graw Hill.
5. Hydrology & Flood Control by Santosh Kumar - Khanna Publishers
6. Engg. Hydrology by H.M. Raghunath

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	Operation Research	3L : 2T : 0P (5 hrs.)	4 credits

Course Objective:

Be able to understand the application of OR and frame a LP Problem with solution

Course Contents: (40hrs.)

Module 1 **(08 hrs.)**

Introduction to or and Linear Programming Operation Research – Introduction, OR Models, Areas of Applications - Linear Programming (L.P.) - Formulation of L.P. Problem - Graphical Method - Excel solver – Minimization & Maximization Problems

Module 2 **(08 hrs.)**

Transportation & Assignment Models Transportation Models - Balanced / Unbalanced, Minimization / Maximization - The Northwest Method, The Lowest Cost Method – Vogel‘s Approximation Method - The Stepping Stone Method – Modified Distribution (MODI) Method - Cases of degeneracy. Transportation problem with TORA . The Assignment Model (Hungarian Method) - Basic Assumptions

Module 3 **(08 hrs.)**

Network Analysis & Queuing Theory Construction of Network – Rules & Precautions - C.P.M. & P.E.R.T. Networks - Obtaining of Critical Path - Time estimates for activities - Probability of completion of project - Determination of floats (total, free, independent & interfering). Queuing Theory - Single and Multi - Channel Models

Module 4 **(08 hrs.)**

Decision Theory and Replacement Models Decision making under risk – Decision trees – Decision making under uncertainty. Application of simulation techniques for decision making. Replacement Models - Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value - Replacement of items that fail suddenly - Individual replacement policy & group replacement policy.

Module 5 **(08 hrs.)**

Game Theory and Sequencing Game Theory – Definition – Saddle Point - Two Person Zero Sum Game - Pure and Mixed Strategies - Algebraic Solution Procedure - Graphical Solution – Principle of Dominance . Sequencing Problem - Processing of n Jobs through Two Machines and m Machines - Graphical Method of Two Jobs m Machines Problem.

Course Outcomes:

CO1 Be able to understand the application of OR and frame a LP Problem with solution – graphical and through solver add in excel (software).

CO2 Be able to build and solve Transportation and Assignment problems using appropriate method.

CO3 Be able to design and solve simple models of CPM and queuing to improve decision making and develop critical thinking and objective analysis of decision problems.

CO4 Be able to solve simple problems of replacement and implement practical cases of decision making under different business environments.

CO5 Enables to take best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models.

Reference Books:

1. KantiSwarup, P K Gupta, Man Mohan, Operations Research, Sultan Chand &Sons , 2014.
2. Sharma J K - Operations Research, Pearson

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	Design of Masonry Structures	**3L : 2T : 0P (5 hrs.)**	**4 credits**

Course Objective:

Be able to understand properties of masonry units, strength and factors affecting strength.

Course Contents: (40hrs.)

Module 1 **(08 hrs.)**

Masonry Units, Materials, Types and Masonry Construction: Bricks, Stone and Block masonry units- strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks. Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

Module 2 **(08 hrs.)**

Permissible Stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses. Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.

Module 3 **(08 hrs.)**

Load Considerations and Design of Masonry Subjected to Axial Loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.

Module 4 **(08 hrs.)**

Design of Walls Subjected to Concentrated Axial Loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings. Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Module 5 **(08 hrs.)**

Design of Laterally and Transversely Loaded Walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs. In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Course Outcomes:

CO1: Explain engineering properties, uses of masonry units, defects, crack in masonry and its remedial measures and factors affecting compressive strength of masonry units.

CO2: Explain the different masonry elements, permissible stresses, design considerations and criteria as per IS: 1905 and SP-20.

CO3 :Design different types of masonry walls subjected to axial loads.

CO4: Design different types of masonry walls subjected to concentrated axial loads.

CO5: Design different types of masonry walls subjected to eccentric loads

Reference Books:

1. Henry, A.W., " Structural Masonry" , Macmillan Education Ltd., 1990.
2. Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH, 1987.
3. M. L. Gambhir, " Building and Construction Materials", Mc Graw Hill education Pvt. Ltd.
   Reference Books:
4. IS 1905–1987 "Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi
5. SP 20 (S&T) – 1991, "Hand book on masonry design an d construction (1 st revision) BIS, New Delhi.