VARDHAMAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade, **ISO 9001:2015** Certified

Kacharam, Shamshabad, Hyderabad - 501218, Telangana, India

www.vardhaman.org

CURRICULUM

For

Bachelor of Technology

Civil Engineering

Under

Choice Based Credit System (CBCS)

B. Tech. - Regular Four-Year Degree Program

(For batches admitted from the Academic Year 2022 - 2023)

&

B. Tech. - Lateral Entry Scheme

(For batches admitted from the Academic Year 2023 - 2024)

October 2022

Vision of the Institution:

To be a pioneer institute and leader in engineering education to address societal needs through education and practice.

Mission of the Institution:

- To adopt innovative student centric learning methods.
- To enhance professional and entrepreneurial skills through industry institute interaction.
- To train the students to meet dynamic needs of the society.
- To promote research and continuing education.

Vision of the Department:

To be a center of excellence in civil engineering education, research and consultancy to support community directly or indirectly.

Mission of the Department:

- To adopt processes enhancing student learning experience and professional skills.
- To enhance entrepreneurial skills among the students through Industry Institute Interactions.
- To work in-tandem with industry to facilitate advancement of technology for societal needs.
- To promote research and continuing education through multi-disciplinary activities.

Program Educational Objectives(PEOs):

PEO1: Graduates as structural engineers will enhance their analytical skills to face technological challenges by solving real-world problems.

PEO2: Graduates through lifelong learning will acquire advanced technical skills and the ability to design and execute projects in a constantly changing environment.

PEO3: Graduates will effectively communicate their ideas to collaborate with industry and R&D centers, work as a team member or leader to meet the obligations to the highest standards.

PEO4: Graduates will investigate and implement socially and economically viable solutions to open-ended engineering tasks that span multiple disciples while upholding professional and ethical standards of civil engineers.

Program Outcomes(POs):

PO1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2:Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3:Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4:Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5:Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6:The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7:Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10:Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11:Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12:Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes(PSOs):

Graduates will be able to,

PSO1: Prepare detailed project reports and execution of industrial projects.
PSO2: Provide solutions for irrigation, drainage and rural water supply.

Programme Curriculum Structure
B. Tech – Civil Engineering

Regulations: VCE-R22

I Year I Semester										
Induction Program (Phase – I)										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8001	Matrices and Calculus	BS	3	1	0	4	40	60	100
2	A8006	Applied Physics	BS	3	0	0	3	40	60	100
3	A8503	C Programming and Data Structures	ES	3	0	0	3	40	60	100
4	A8101	Construction Materials	ES	3	0	0	3	40	60	100
5	A8303	Engineering Drawing	ES	1	0	4	3	40	60	100
6	A8007	Applied Physics Laboratory	BS	0	0	2	1	40	60	100
7	A8504	C Programming and Data Structures Laboratory	ES	0	0	2	1	40	60	100
8	A8301	Engineering Workshop	ES	0	0	2	1	40	60	100
9	A8021	Social Innovation	ES	0	0	2	1	40	60	100
Total				13	01	12	20	360	540	900

I Year II Semester										
Induction Program (Phase – II)										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8002	Ordinary Differential Equations and Vector Calculus	BS	3	1	0	4	40	60	100
2	A8008	Engineering Chemistry	BS	3	0	0	3	40	60	100
3	A8010	English for Skill Enhancement	HS	2	0	0	2	40	60	100
4	A8102	Engineering Geology	ES	3	0	0	3	40	60	100
5	A8103	Applied Mechanics	ES	3	0	0	3	40	60	100
6	A8009	Engineering Chemistry Laboratory	BS	0	0	2	1	40	60	100
7	A8011	English Language and Communication Skills Laboratory	HS	0	0	2	1	40	60	100
8	A8104	Engineering Geology Laboratory	ES	0	0	2	1	40	60	100
9	A8508	Python Programming Laboratory	ES	0	0	2	1	40	60	100
10	A8022	Engineering Exploration	ES	0	0	2	1	40	60	100
Total				14	01	10	20	400	600	1000

Programme Curriculum Structure
B. Tech – Civil Engineering

Regulations: VCE-R22

II Year I Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8003	Probability Distributions and Statistics	BS	3	1	0	4	40	60	100
2	A8105	Building Construction and Planning	ES	3	0	0	3	40	60	100
3	A8106	Strength of Materials - I	ES	3	0	0	3	40	60	100
4	A8107	Surveying	PC	3	0	0	3	40	60	100
5	A8108	Fluid Mechanics	PC	3	0	0	3	40	60	100
6	A8109	Strength of Materials Laboratory	PC	0	0	2	1	40	60	100
7	A8110	Surveying Laboratory	PC	0	0	2	1	40	60	100
8	A8111	Computer Aided Drafting Laboratory	PC	0	0	2	1	40	60	100
9	A8023	Engineering Design Thinking	PW	0	0	2	1	40	60	100
Total				15	01	08	20	360	540	900
Mandatory Courses (Non-Credit)										
10	A8031	Gender Sensitization	MC	2	0	0	0	-	100	100
11	A8033	Universal Human Values 2: Understanding Harmony	MC	2	0	0	0	-	100	100

II Year II Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8013	Business Economics and Financial Analysis	HS	3	0	0	3	40	60	100
2	A8112	Strength of Materials - II	PC	3	0	0	3	40	60	100
3	A8113	Hydraulics and Hydraulic Machines	PC	3	0	0	3	40	60	100
4	A8114	Concrete Technology	PC	3	0	0	3	40	60	100
5	A8115	Structural Analysis	PC	3	1	0	4	40	60	100
6	A8316	Fluid Mechanics and Hydraulic Machines Laboratory	PC	0	0	2	1	40	60	100
7	A8116	Concrete Technology Laboratory	PC	0	0	2	1	40	60	100
8	A8117	Advanced Surveying Laboratory	PC	0	0	2	1	40	60	100
9	A8024	Product Realization	PW	0	0	2	1	40	60	100
Total				15	01	08	20	360	540	900
Mandatory Courses (Non-Credit)										
10	A8032	Environmental Science and Technology	MC	2	0	0	0	-	100	100

Programme Curriculum Structure
B. Tech – Civil Engineering

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III Year I Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8118	Design of Reinforced Concrete Structures	PC	3	1	0	4	40	60	100
2	A8119	Water Resources Engineering	PC	3	1	0	4	40	60	100
3	A8120	Geotechnical Engineering	PC	3	0	0	3	40	60	100
4	A8121	Transportation Engineering	PC	3	0	0	3	40	60	100
5		Professional Elective - I	PE	3	0	0	3	40	60	100
6	A8122	Geotechnical Engineering Laboratory	PC	0	0	2	1	40	60	100
7	A8123	Transportation Engineering Laboratory	PC	0	0	2	1	40	60	100
8	A8124	Civil Engineering Software Laboratory	PC	0	0	2	1	40	60	100
Total				15	02	06	20	320	480	800
Mandatory Courses (Non-Credit)										
9	A8034	Indian Constitution	MC	2	0	0	0	-	100	100

III Year II Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8125	Design of Steel Structures	PC	3	0	0	3	40	60	100
2	A8126	Advanced Structural Analysis	PC	3	0	0	3	40	60	100
3	A8127	Environmental Engineering	PC	3	0	0	3	40	60	100
4		Professional Elective – II	PE	3	0	0	3	40	60	100
5		Professional Elective – III	PE	3	0	0	3	40	60	100
6	A8128	Environmental Engineering Laboratory	PC	0	0	2	1	40	60	100
7	A8129	Structural Analysis and Design Laboratory	PC	0	0	2	1	40	60	100
8	A8012	Advanced English Communication Skills Laboratory	HS	0	0	2	1	40	60	100
9	A8041	Mini-Project / Internship	PW	0	0	4	2	40	60	100
Total				15	0	10	20	360	540	900
Mandatory Courses (Non-Credit)										
10	A8035	Research Methodology	MC	2	0	0	0	-	100	100

Programme Curriculum Structure
B. Tech – Civil Engineering

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IV Year I Semester											
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8130	Remote Sensing and GIS	PC	3	0	0	3	40	60	100
2	A8131	Estimation and Costing	PC	3	0	0	3	40	60	100
3		Professional Elective – IV	PE	3	0	0	3	40	60	100
4		Professional Elective – V	PE	3	0	0	3	40	60	100
5		Open Elective – I	OE	3	0	0	3	40	60	100
6	A8132	Geographical Information Systems Laboratory	PC	0	0	2	1	40	60	100
7	A8133	Building Information Modeling Laboratory	PC	0	0	2	1	40	60	100
8	A8042	Project Work Phase – I	PW	0	0	6	3	100	-	100
Total				15	0	10	20	380	420	800

IV Year II Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1		Professional Elective – VI	PE	3	0	0	3	40	60	100
2		Open Elective – II	OE	3	0	0	3	40	60	100
3		Open Elective – III	OE	3	0	0	3	40	60	100
4	A8043	Project Work Phase - II	PW	0	0	22	11	40	60	100
Total				09	0	22	20	160	240	400

Programme Curriculum Structure
B. Tech – Civil Engineering

Regulations: VCE-R22

List of Professional Electives

Professional Elective - I		
Domain	**Course Code**	**Title of the Course**
Infrastructure Engineering	A8151	Construction Management
Geotechnical Engineering	A8152	Subsurface Exploration
Transportation Engineering	A8153	Intelligent Transportation Systems
Water Resources and Environmental Engineering	A8154	Air Pollution and Control Technologies

Professional Elective - II		
Domain	**Course Code**	**Title of the Course**
Infrastructure Engineering	A8155	Green Building and Sustainability
Geotechnical Engineering	A8156	Advanced Geotechnical Engineering
Transportation Engineering	A8157	Pavement Engineering
Water Resources and Environmental Engineering	A8158	Watershed Management

Professional Elective - III		
Domain	**Course Code**	**Title of the Course**
Infrastructure Engineering	A8159	Repair and Rehabilitation of Structures
Geotechnical Engineering	A8160	Ground Improvement Techniques
Transportation Engineering	A8161	Traffic Engineering
Water Resources and Environmental Engineering	A8162	Ground Water Hydrology

Programme Curriculum Structure
B. Tech – Civil Engineering

Regulations: VCE-R22

List of Professional Elective (Cont.)

Professional Elective - IV		
Domain	**Course Code**	**Title of the Course**
Infrastructure Engineering	A8163	Elements of Earthquake Engineering
Geotechnical Engineering	A8164	Environmental Geotechnology
Transportation Engineering	A8165	Railway, Airport, Waterway and Harbour Engineering
Water Resources and Environmental Engineering	A8166	Environmental Impact Assessment

Professional Elective - V		
Domain	**Course Code**	**Title of the Course**
Infrastructure Engineering	A8167	Prestressed Concrete Structures
Geotechnical Engineering	A8168	Geotechnical Earthquake Engineering
Transportation Engineering	A8169	Road Safety Engineering
Water Resources and Environmental Engineering	A8170	Irrigation Engineering

Professional Elective - VI		
Domain	**Course Code**	**Title of the Course**
Infrastructure Engineering	A8171	Finite Element Method
Geotechnical Engineering	A8172	Designing with Geosynthetics
Transportation Engineering	A8173	Urban Transportation Systems Planning
Water Resources and Environmental Engineering	A8174	Solid and Hazardous Waste Management

List of Open Electives

#	Course Code	Title of the Course
1	A8181	Smart Cities
2	A8182	Disaster Management
3	A8183	Environmental Pollution Management
4	A8155	Green Building and Sustainability
5	A8224	Electric Vehicles
6	A8281	Solar Energy and Applications
7	A8282	Energy Storage Systems
8	A8283	Power Generation Systems
9	A8381	Hybrid Vehicles
10	A8382	Fundamentals of Robotics
11	A8383	3D Printing
12	A8402	Digital Electronics
13	A8481	Basic Electronics
14	A8482	Principles of Communication Engineering
15	A8483	Fundamentals of IoT
16	A8484	Introduction to Embedded Systems
17	A8510	Operating Systems
18	A8514	Database Management Systems
19	A8520	Software Engineering
20	A8607	Information Security
21	A8608	Java Programming
22	A8651	Ethical Hacking
23	A8652	Cyber Security
24	A8656	Blockchain Technology
25	A8658	Robotic Process Automation
26	A8681	E-Commerce
27	A8682	Full Stack Development
28	A8702	Artificial Intelligence
29	A8781	Computer Organization and Architecture
30	A8851	Data Science for Engineers
31	A8081	Mathematical Programming
32	A8082	Transform Calculus
33	A8083	Numerical Techniques
34	A8084	Entrepreneurship Development
35	A8085	Logistics and Supply Chain Management

List of Open Electives (Cont.)

#	Course Code	Title of the Course
36	A8086	Management Science
37	A8087	Human Resource Management
38	A8088	Organizational Behaviour
39	A8089	Intellectual Property Rights
40	A8090	Professional Practice, Law & Ethics
41	A8091	National Cadet Corps (NCC)

I YEAR I SEMESTER

Course Structure

A8001 - Matrices and Calculus

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the solution of system of linear equations, eigen values and eigen vectors, functions of several variables, multiple integrals. In addition, this course can be applied in many areas of engineering such as computer graphics, cryptography, wireless communication and animation.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8001.1. Solve system of linear equations using rank of a matrix.
A8001.2. Examine the nature of quadratic form using eigen values and eigen vectors.
A8001.3. Evaluate improper integrals using Beta and Gamma Functions.
A8001.4. Examine the extremum of a function of several variables.
A8001.5. Make use of multiple integrals to find the area and volume of a solid.

3. Course Syllabus

Theory of Matrices: Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss- Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

Eigen Values and Eigen Vectors: Linear Transformation and Orthogonal Transformation, Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem. Rank, index, signature and nature of quadratic forms up to three

variables using eigen values.

Calculus: Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem, Taylor's Series, Definition of Improper Integral: Beta and Gamma functions and their applications.

Multivariable Calculus (Partial Differentiation and applications): Definitions of Limit and Continuity, Partial Differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

Multivariable Calculus (Integration): Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Change of variables (Cartesian to polar), Evaluation of Triple Integrals. Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

4. Books and Materials

Text Books:

1. Grewal, B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Jain, R.K. and Iyengar, S.R.K. Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing House, 2011.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V. Higher Engineering Mathematics, 32nd Reprint, McGraw Hill Education (India) Pvt Ltd, 2018.

Course Structure

A8006 - Applied Physics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Applied Physics course introduces the fundamental aspects of physics with applications to modern scientific world and focuses on recent trends in science and technology. This interdisciplinary knowledge which includes quantum computing, semiconductors, lasers, wave optics, optical fibers and nanomaterials encourage an understanding of technological applications of Physics. It's importance as a subject of social and industrial relevance enable the students to solve various engineering problems.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8006.1. Analyze the properties of quantum computers by quantum physics.
A8006.2. Apply wave property of light to study different optical phenomenon.
A8006.3. Interpret the charge carrier dynamics in semiconductors.
A8006.4. Develop communication systems by means of lasers and optical fibers.
A8006.5. Analyze the principles of nanoscience and technology for electronic applications.

3. Course Syllabus

Quantum Mechanics and Quantum Computing: Introduction to quantum physics, Blackbody radiation, Photoelectric effect, de-Broglie hypothesis, G.P. Thomson experiment, Concept of wave function, Heisenberg uncertainty principle, Time independent Schrödinger wave equation, One-dimensional potential box, Introduction to quantum computing, Bits and qubits, Classical and quantum logic gates, Interference and quantum entanglements, quantum teleportation and cryptography, IBM quantum, Application of quantum computers.

Wave optics: Waves and wavefronts, Huygens' principle, Superposition of waves, Constructive and destructive interference, Interference of light by Wavefront splitting – Young's double slit experiment, Amplitude splitting – Newton's rings, Diffraction: Fraunhofer and Fresnel diffraction, Diffraction of light at single slit, Diffraction grating – Intensity distribution of light.

Semiconductors and Devices: Intrinsic and extrinsic semiconductor, Density of states, Fermi-Dirac distribution function, Carrier concentration in intrinsic semiconductor, Direct and indirect bandgap semiconductor, Structure, Working principle and Characteristics of P-N junction diode, Hall effect, Light Emitting Diode (LED) and Solar cell.

Lasers and Optical fibers: Introduction to lasers, Einstein's coefficients, three and four level laser systems, Ruby laser, He-Ne laser, Semiconductor laser, Applications of lasers, Introduction to optical fibers, Structure of optical fiber, Total internal reflection, Step index and Graded index optical fibers, Acceptance angle - Numerical aperture, Optical fibers in communication System, Applications of optical fibers.

Nanoscience: Introduction of nanomaterials, Surface area to Volume ratio, Quantum confinement, Top-down fabrication: Ball milling and Chemical Vapor Deposition (CVD) methods, Bottom-up fabrication: Sol-Gel and Combustion methods, Characterization techniques: X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Applications of nanomaterials.

4. Books and Materials

Text Books:

1. Pandey, B. K. and Chaturvedi, S., Engineering Physics, 1st Edition, New Delhi: Cengage Learning India Pvt. Ltd, 2013
2. Bernhardt, Chris., Quantum computing for everyone, MIT Press, 2019.

Reference Books:

1. Palanisamy, P.K, Engineering Physics, 1st Edition, Scitech Publications, 2013
2. David Halliday, Jearl Walker, Robert Resnick, David G. Rethwisch, William D. Callister, Engineering Physics, 6th Edition, Wiley India Pvt Ltd, 2006
3. Brij Lal and Subrahmaniyam, A textbook of Optics, 23rd Edition, S Chand, 2006.

Course Structure

A8503 - C Programming and Data Structures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

C Programming and Data Structures is a course of primary importance to the discipline of any Engineering Graduate, it is a mathematical and logical model of organizing data and also used in designing and implementing efficient algorithms. Study of the C programming language that covers the syntax and constructs of data types, control statements, arrays, functions, pointers and structures. C programming language Concepts are used to implement the concepts of Data Structures. Data structures like linked lists, stacks and queues will be discussed to implement real time applications in various domains. The course also includes non-linear data structures like Trees and Graphs which are especially used to handle large amount of data.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8503.1. Identify the various building block of C for solving a given problem.
A8503.2. Make use of Arrays, functions, pointers and structures to organize data.
A8503.3. Chose appropriate linear data structure for a given task.
A8503.4. Identify various Non Linear data structures for large amount of data.
A8503.5. Select appropriate searching and sorting technique for given data.

3. Course Syllabus

C Overview: Structure of a C Program, Identifiers, Variables, Constants and Data Types. Operators-Arithmetic, Relational, Logical, Assignment, increment and decrement, Conditional, Bitwise and Special Operators. Evaluation of Expressions, Precedence of Arithmetic operators, Type conversions, Operator precedence and Associativity. Formatted input and output. Control Statements: Conditional Statements- if, if else, nested if, else if ladder and switch statements. Iterative or Loop statements- while, do while and for statements. Jump statements- break, continue and goto statements.

Arrays, Functions, Structures and Pointers: Arrays: one dimensional arrays, two dimensional arrays, string manipulation functions. Functions- categories of user defined functions, parameter passing techniques, recursion. Pointers- declaration, initialization, pointer to pointer, dynamic memory allocation, command line arguments. Structures- declaration, initialization, accessing the members, pointers to structures.

Linear Data Structures: Introduction, Classification of Data Structures, Operations on Data Structures, Stacks: Introduction, Array Representation of Stack, Operations on Stack. Applications of Stacks: towers of Hanoi, Infix-to- Postfix conversion, evaluating Postfix expressions. Queues: Introduction, Array representation of Queue, Operations on a Queue, Circular Queue.

Linked Lists, Trees and Graphs: Introduction, Singly Linked List: Representation of a Singly Linked List, Operations on a Singly Linked List and Doubly linked list. Trees- Definition, Basic Terminologies, Representation of a Binary Tree using Array and Linked List, Operations on a Binary Tree: create, insert, Tree Traversals. Graphs: Definition, Basic Terminologies and Representation.

Searching and Sorting Techniques: linear search, binary search, bubble sort, selection sort, insertion sort, merge sort and Quick sort.

4. Books and Materials

Text Books:

1. Byron Gottfried., Programming with C,4th Edition, Mc GRAW HILL Edition, 2018.
2. ReemaThareja., Data Structures Using C,2nd Edition, Oxford University Press India,2014.

Reference Books:

1. P. Padmanabham., C & Data structures,3rd Edition, B.S. Publications, 2016.
2. E Balagurusamy.,Programming in ANSI C,8th Edition, Tata McGRAW HILL, New Delhi, 2019.

Course Structure

A8101 - Construction Materials

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course deals with the construction materials that are being used since ages as well as the present trending materials. The course also gives an overview on the importance of sustainable construction. This course is foundational course for advanced courses like building construction and planning and construction management.

Course Pre/co-requisites

The course has no specific pre-requisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8101.1. Categorize building stones, bricks and concrete blocks.
A8101.2. Explain properties of aggregates, mortars, binders, and concrete.
A8101.3. Select suitable wood, metals and finishing materials for civil engineering structures.
A8101.4. Make use of advanced materials for sustainable environment.
A8101.5. Choose composite materials for civil engineering structures.

3. Course Syllabus

Stones, Bricks, Concrete Blocks: Stone as building material, Criteria for selection of stones, Tests on stones, Deterioration and Preservation of stone work. Bricks, Classifications, Manufacturing of clay bricks, Field and laboratory tests on bricks, Refractory bricks. **Concrete blocks:** Cement Concrete blocks, Autoclaved Aerated Concrete Blocks, Sizes, requirement of good blocks.

Lime, Cement, Aggregate and Mortar: Lime, Preparation of lime mortar, Cement, Ingredients of cement, Manufacturing process of cement, Types and Grades of cement, Properties and tests on cement. Fine aggregates, river sand, manufactured sand, Properties of fine aggregate. Coarse aggregate and their properties, Cement mortar.

Concrete: Concrete and its Ingredients, Manufacturing Process, batching plants, mixing, transporting, placing, compaction of concrete, curing and finishing of concrete, Ready mix Concrete, Mix specification.

Timber, Steel, Aluminium and Paint: Timber-Classification of timber trees, cross section of exogenous tree, hard wood and soft wood, seasoning of timber, ply wood and its uses.
Steel, Aluminium and Paint: Types of steel-mild steel, high carbon steel, high strength steel properties and uses, light Guage steel, commercial forms of steel and aluminium and their uses. Painting, Constituents of paint, Types of paints, Painting of old Wood and Varnish.

Sustainable Materials: Introduction to sustainability, importance of sustainable materials, Fly ash, GGBS, Micro Silica, recycled aggregate, Bamboo, Metakaolin, lime stone calcined clay cement, waste plastic.
Composite Materials: Types – Applications of laminar composites, fiber reinforced polymer composites, ferro cement, Fibre textiles– Geomembranes and Geotextiles for earth reinforcement.

4. Books and Materials

Text Books:

1. S.K. Duggal, Building Materials, 4th Edition, New Age International Publishers, 2012.
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Building Construction, Laxmi Publications (P) ltd., New Delhi, India, 11th Edition, 2019.

Reference Books:

1. M.S. Shetty, A.K. Jain, Concrete Technology, S. Chand Publisher, 2019.

Course Structure

A8303 - Engineering Drawing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
1	0	4	15	0	60	3	40	60	100

1. Course Description

Course Overview

Engineering drawing is said to be the language of engineers. It is the graphical representation of objects and their relationships based on certain basic principles and standard conventions. It can be regarded as a powerful tool to convey ideas. This course is included in all engineering curricula with the aim of training the students and making them graphically literate. This course covers orthographic projections for points, lines, planes and solids in different positions, the development of lateral surfaces and the isometric projections. The students are able to create simple solid models of various domain applications.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8303.1. Construct various types of scales and curves used in engineering practice..
A8303.2. Describe the location of objects referring to the principal planes of projection.
A8303.3. Create orthographic views of points, lines, planes and solids appropriate to the projection system in use.
A8303.4. Develop the lateral surface areas of regular solids by construction methods.
A8303.5. Generate 3-dimentional views of simple objects using isometric coordinates.

3. Course Syllabus

Introduction to Engineering Drawing:: Principles of engineering drawing and their significance. Construction of scales – Plane, Diagonal and Vernier scales. Construction of engineering curves,Ellipse, Parabola, Hyperbola (General method only) cycloid, Epicycloid, Hypocycloid and Involutes.

Orthographic Projections-I: Principles of orthographic projections. Projections of point, line, and plane - inclined to one plane and inclined to both principal planes.

Orthographic Projections-II: Orthographic projections of Prism, Cylinder, Pyramid and Cone - inclined to one plane and inclined to both principal planes.

Development of Lateral Surfaces: Development of Regular Solids – Prism, Cylinder, Pyramid and Cone.

Isometric Projections: Concept of isometric projection – Isometric scale – Isometric view of Line, regular Plane and Solid. Conversion of isometric view to orthographic views and vice-versa.

4. Books and Materials

Text Books:

1. Bhatt N.D., Panchal V.M., Ingle P.R.,"Engineering Drawing", 53rd Edition,Charotar Publishing House, 2019
2. Basant Agrawal, C. M. Agrawal,"Engineering Graphics",3rd Edition,TMH Publication,2010.

Reference Books:

1. Narayana, K.L., P Kannaiah,"Text book on Engineering Drawing",3rd Edition, Sci-TechPublishers, 2020.
2. K. Balaveera Reddy et al, Computer Aided Engineering Drawing, 2nd Edition, Scitech Publications, 2013
3. Shah, M.B., Rana B.C., Engineering Drawing and Computer Graphics, 2nd Edition, Pearson Education, 2009

Course Structure

A8007 - Applied Physics Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Applied Physics Laboratory covers the concepts of semiconductors, communication systems and wave optics. These experiments have number of applications and are valuable tool in the arsenal of engineers across multiple domains. This course also makes students familiar with the instrumental methods and various electrical properties of semiconducting devices. This basic knowledge will enable the scientific fervor to solve various engineering problems.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8007.1. Evaluation of properties of light radiation by wave optics.
A8007.2. Interpret the principles of semiconductors.
A8007.3. Determine the properties of laser light and estimate losses in optical fibre.
A8007.4. Analyze the VI characteristics of LED and solar cell.
A8007.5. Apply resonance principle to calculate frequency of AC supply.

3. List of Experiments

1. Determination of the wavelength of Sodium light by Newton's rings method.
2. Determination of wavelengths of spectral lines of Mercury (Hg) source using diffraction grating.
3. Determination of threshold voltage and study the V-I characteristics of LED.
4. To Study the V-I characteristics of PN junction diode under Forward and Reverse bias conditions.
5. Verification of the type of semiconductor material by estimating the density of majority carriers using Hall Effect.
6. Determination of the energy bandgap of a given semiconductor.
7. Determination of quality factor of solar cells and it's V-I Characteristics.

8. Determination of the wavelength of a given source of Laser light using plane transmission grating.
9. Evaluation of the numerical aperture (NA) and transmission losses of a given optical fiber.
10. Evaluation of frequency (n) of an AC supply, using Sonometer.

4. Laboratory Equipment/Software/Tools Required

1. Newton's Ring kit
2. Spectrometer
3. Regulated power supply (DC and AC)
4. Hall Effect Setup
5. Light Emitting Diode Kit
6. Solar cell Kit
7. Sonometer Setup
8. Semiconductor Laser Source
9. Plane diffraction grating
10. Optical fiber trainer kit
11. Meters - Ammeter, Voltmeter, Digital Multimeter
12. Diodes, Resistors, Capacitors, Bread Board

5. Books and Materials

Text Books:

1. Sushil Kumar Jain, Majeet Singh, Applied Physics Experiments, JBC Press, 2013

Reference Books:

1. S B Mal, Er. Ashish Jesuja Practical Physics for Engineering Students of B.Tech, JBC Press, 2015
2. Applied Physics Laboratory Manual, Department of Physics, VCE 2022

Course Structure

A8504 - C Programming and Data Structures Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

C Programming and Data Structures laboratory is a course of primary importance to the discipline of any Engineering Graduate, it is a mathematical and logical model of organizing data and also used in designing and implementing efficient algorithms. This course enables the students to solve problems using C building blocks, Linear and Non Linear data structures. It is a basic course to learn any programming language.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8504.1. Make use of various constructs of C programming to solve a given problem.
A8504.2. Choose the concepts of arrays, functions, pointers and structures to organize data.
A8504.3. Develop programs using linear and nonlinear data structures for insert and delete operations on data.
A8504.4. Select appropriate searching and sorting for given data.

3. List of Experiments

1. a) Write a C program to evaluate arithmetic expressions.
   b) Write a C program to calculate simple interest.
   c) Write C program for Swapping of two numbers using a third variable.
2. a) Write C program to Find the maximum and minimum of 2 numbers.
   b) Write a C program to find roots of a quadratic equation.
   c) Write a C program to find the reverse of a given number.
   d) Write a C program to check a number is prime or not.
3. a) Write C program to Find the largest and smallest number among a list of integers.
   b) Write a C program to find multiplication of two matrices.
   c) Write a C program to demonstrate the string handling functions.

d) Write a C program to Check whether the given string is palindrome or not with string functions.

4. a) Write a C program to find the factorial of a number using non-recursion.
   b) Write a C program to find the nth Fibonacci term using non-recursion.
   c) Write a C program to find the factorial of a number using recursion.
   d) Write a C program to find the nth Fibonacci term using recursion.
5. a) Write a C program to Read an array of integers whose size will be specified interactively at rum time
   b) Write a C program to Pass n number of arguments at the command line and display total number of arguments and their names.
   c) Write a C program to Create a Student structure containing name, rollNo and grade as structure members. Display the name, rollNo and grade of a student.
6. a) Implement stack operations using arrays.
   b) Implementing towers of Hanoi.
7. a) Converting infix expression to postfix expression.
   b) Evaluate the postfix expression
8. a) Implement Queue using arrays .
   b) Implement Circular Queue using arrays.
9. Implement single linked list operations like insert, delete and display.
10. Implement Traversals on Binary Tree using linked list.
11. a) Implement Linear Search
    b) Implement Binary search
12. a) Implement Bubble sort
    b) Implement Selection sort
13. a) Implement Quick sort
    b) Implement Merge sort

4. Laboratory Equipment/Software/Tools Required

1. Computer Systems (PCs) installed with Ubuntu OS (Open Source/ Freeware)
2. GCC Compiler (Open source / Freeware).

Course Structure

A8301 - Engineering Workshop

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Engineering Workshop is an establishment of space and facility where the students acquire the knowledge on different materials, equipment, tools and workshop practices that are the core methods of engineering industry. This course is of prime importance which makes the learner competent in handling practical work in all types and trades of engineering. It also develops the skills with dignity of labour, precision, safety at work place, team working innovative ideas in making and development of right attitude.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8301.1. Identify the trade based materials and tools to prepare the models.
A8301.2. Illustrate each trade and tool by hands on training in making the models.
A8301.3. Apply different workshop practice methods towards workshop models.
A8301.4. Analyze the trade based operations in the process of product development.
A8301.5. Develop a progressive product towards a societal need.

3. Course Syllabus

PART – A (Demonstration)

1. CNC Machining.
2. Additive Manufacturing with one Model.
3. Power Tools, Plastic Moulding, Metal Casting.
4. Welding (TIG/MIG, Gas Welding), Brazing.

PART - B (Practical)

1. Fitting : L - Fit / V - Fit / Square – Fit / Semi Circular - Fit.
2. Carpentry : Cross Lap Joint / Dovetail Joint / T – Lap Joint / Corner Lap Joint.
3. House wiring : Series / Parallel / One Bulb One Switch / Tube Light / Two-way switch.

4. Welding : Butt Joint / Lap Joint / T Joint .
5. Foundry : Single Piece / Multi Piece.
6. Tin Smithy : Open Scoop / Funnel / Rectangular Tray / Cylindrical
7. Plumbing : Pipe Threading / Pipe Joints.

Note: Minimum one experiment from each Trade with total of 12 Experiments

4. Laboratory Equipment/Software/Tools Required

1. Fitting : Bench vise, Hacksaw frame, Calipers, Files, Try Square
2. Carpentry : Carpentry vise, Chisels, Saws, Wooden Hammer, Try Square
3. House wiring : Wiring Bundles, Socket Pins, Tester, Poker, and Cutting Plier
4. Welding : Welding M/c, Safeguards, Chipping Hammer, Electrode Holder
5. Foundry : Wooden patterns, Riddle, Riser, Runner, Gate cutter, Rammers
6. Tin Smithy : Wire Gauge, Snips, Pliers, Steel rule, Soldering kit, Nylon Hammers.
7. Plumbing : Pipe Wrench, Pipe Cutter, Pliers, Pipe Die Set
8. Additional : Model Joints and Electric Boards

Course Structure

A8021 - Social Innovation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Social Innovation is an open-ended course to develop social connectedness in engineering students through social awareness and social consciousness. This can be done through live field exposure along with faculty led conceptual presentations, real case reviews, self-study assignments, literature and field survey. Through this course, the students are expected to use their engineering knowledge to provide innovative solutions to existing social problems. This course also develops critical thinking ability among the students to develop sustainable solutions.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8021.1. Develop awareness on social issues faced by local regions.
A8021.2. Identify the mind set of human Race and interpret the societal issues as simple, complicated, and complex problems.
A8021.3. Identify the need statement along with its main causes and effects.
A8021.4. Develop an innovative and sustainable solution for social issues by thinking critically and creatively.

3. Course Syllabus

Introduction to Social Innovation: Core definitions, core elements and common features of social innovation, a typology of social innovation, Awakening social consciousness.

Create Mindsets and Wicked Problems: Seven mindsets – Empathy, Optimism, Iteration, Creative confidence, making it, embracing ambiguity, Learning from failures. Distinguish between simple, complicated, and complex problems; describe the characteristics of wicked problems, breakdown a given problem by unpacking its complexity.

Critical and Creative Thinking for Social Innovation: Definition, engineering thinking and learning, distinguish between creativity and innovation. Models of Creative thinking. [Appreciative Inquiry (AI), Asset Based Community Development (ABCD) and Concept of Bricolage.

Process of Social Innovation: Community study, develop questionnaire, identifying the causes of a particular problem, identify needs, record your learning's, generate ideas, select promising ideas, prototyping, and testing.

Social Innovation across Four Sectors: The non-profit sector, public sector, the private sector, the informal sector, links between and cross sectors. Stages of Innovation: Social organizations and enterprises, social movements, social software and open source methods, common patterns of success and failure.

4. Books and Materials

Text Books:

1. Robin Murray, Julie Caulier-Grice, Geoff Mulgan, "The open book of social innovation: Ways to Design, Develop and Grow Social Innovation", The Young Foundation, 2010.
2. Julie Caulier-Grice, Anna Davies, Robert Patrick & Will Norman, The Young Foundation (2012) Social Innovation Overview: A deliverable of the project: "The theoretical, empirical and policy foundations for building social innovation in Europe" (TEPSIE), European Commission – 7th Framework Programme, Brussels: European Commission, DG Research.

Reference Books:

1. Geoff Mulgan, "Social Innovation: What it is, Why it matters and How it can be accelerated", The Young Foundation, 2007.
2. Asset Based Community Development (ABCD) Model – http://www.nurturedevelopment.org/asset-based-community-development/
3. Diana Whitney & Amanda Trosten-Bloom, "The Power of Appreciative inquiry – A Practical Guide to Positive Change", 2nd Edition, Berrett-Koehler Publishers, Inc, 2010.

I YEAR II SEMESTER

Course Structure

A8002 - Ordinary Differential Equations and Vector Calculus

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with ordinary differential equations of first and higher order and Laplace transforms, vector calculus. In addition, this course can be applied in many areas of engineering such as wireless communication, signal processing, robotics and animation.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8002.1. Solve ordinary differential equations of first and higher order.
A8002.2. Make use of ordinary differential equations to solve engineering problems.
A8002.3. Apply Laplace transforms to solve ordinary differential equations.
A8002.4. Determine divergence and curl of a vector point function.
A8002.5. Make use of vector integral theorems to evaluate area, surface area and volumes

3. Course Syllabus

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling, Law of natural growth and decay.

Ordinary Differential Equations of Higher Order: Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type e^{ax}, sin ax, cos ax, polynomials in x, e^{ax} V(x) and xV(x), method of variation of parameters, Equations reducible to linear ODE with constant coefficients: Cauchy-Euler equation. Applications:

L-C-R Circuits.

Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by 't', Laplace transforms of derivatives and integrals of function, Evaluation of integrals by Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

Vector Differentiation: Vector point functions and scalar point functions, Gradient, Directional derivatives, Divergence and Curl, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

Vector Integral Calculus: Line integral, work done, Surface integrals, Volume integrals. Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem (without proof) and their applications.

4. Books and Materials

Text Books:

1. Grewal, B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Jain, R.K. and Iyengar, S.R.K. Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing House, 2011.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V. Higher Engineering Mathematics, 32nd Reprint, McGraw Hill Education (India) Pvt Ltd, 2018.

Course Structure

A8008 - Engineering Chemistry

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course emphasizes a strong background of Chemistry, infused with an orientation towards the applied chemistry and materials technology. A course that focuses on the general applications of chemical principles to the analysis and evaluation of engineering problems as water and its treatment for various purposes, engineering materials as plastics, fibres, elastomers, composites, non-conventional energy sources, batteries and fuel cells.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8008.1. Apply the knowledge of electrochemical series to protect different metals from corrosion.

A8008.2. Analyze the hardness and other impurities present in the water for industrial and domestic applications.

A8008.3. Evaluate the behaviour of different engineering materials.

A8008.4. Analyze the different types of fossil fuels, characteristics and their applications.

A8008.5. Compare the materials to study various physical and chemical properties.

3. Course Syllabus

Battery Chemistry & Corrosion:

Batteries: Classification – Primary battery (dry cell and lithium cell) and Secondary battery (Lithium-ion cell and lead acid battery). Fuel cells – Hydrogen-Oxygen fuel cell– Engineering applications, Solar cells - Introduction and applications of Solar cells. **Corrosion and Its Control:** Causes and effects of corrosion – Theories of Corrosion – Chemical corrosion – oxidation corrosion, Electrochemical theory of corrosion - mechanism. Types of corrosion – Galvanic corrosion – Concentration cell corrosion (Pitting corrosion and Waterline corrosion). Factors affecting the rate of corrosion, Pilling-Bedworth rule, corrosion

control methods – cathodic protection – sacrificial anodic – impressed current cathodic protection.

Water and its treatment: Introduction – hardness of water – causes of hardness – types of hardness: temporary and permanent – expression and units of hardness, Numerical problems. Boiler troubles: sludges, scales and caustic embrittlement. Internal treatment of boiler feed water – Calgon conditioning – Phosphate conditioning – Colloidal conditioning – Softening of water by ion exchange processes. Potable water – its characteristics. Desalination of water – Reverse osmosis. Sewage – Steps involved in treatment of sewage.

Polymeric Materials: Terminology, Types of Polymerization – Addition and Condensation polymerization with examples. Characteristics of Plastics, fibres and elastomers. Plastics: Thermo- plastic resins & Thermosetting resins. Preparation, properties and engineering applications of Polyvinyl chloride and Teflon. Fibers: Preparation, properties and engineering applications of Nylon-6,6 and Dacron. Elastomers: Natural rubber and its vulcanization, Artificial rubbers - Buna-S and Butyl rubber. Conducting Polymers: Classification, mechanism of conduction in trans - polyacetylene – applications.

Energy Sources: Introduction, Calorific value of fuel – HCV, LCV- Dulongs formula – Numerical Problems. Classification- solid fuels – coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining, Cracking and its types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition, characteristics and applications of LPG and CNG, Biodiesel – Transesterification, advantages

Engineering Materials:
Nanomaterials: Introduction, Chemical synthesis by sol-gel, precipitation, solvo-thermolysis and thermolysis methods. Applications of nanomaterials in Industry and Engineering.
Graphene: Isolation, Structure and strength, applications in Computer, Electrical and Electronic Devices.
Alloys: Definition – Purpose of alloying, Types of alloys – Ferrous Alloys (Stainless steel, Nichrome, Alnico), Non-ferrous alloys (solder, brass and bronze).
Portland cement: Chemical constituents, Setting and Hardening and applications of cement.

4. Books and Materials

Text Books:

1. Rama Devi. B, Aparna. P, Prasanta Rath, Engineering Chemistry, 2nd Edition, Cengage

Publications, 2022.

2. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publication Company, 2015.

Reference Books:

1. Shikha Agarwal, Engineering Chemistry, Cambridge University Press, Delhi, 2015.
2. Shashi Chawla, Engineering Chemistry, Dhanpatrai and Company (P) Ltd. Delhi, 2011.
3. Thirumala Chary. M, Laxminarayana. E and Shashikala. K, A text book of Engineering Chemistry, Pearson Publications, 2021.

Course Structure

A8010 - English for Skill Enhancement

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	2	40	60	100

1. Course Description

Course Overview

This course has been designed to develop linguistic and communicative competencies among engineering students. The Reading and Writing skills of the students are honed during the sessions using the prescribed textbook. Additional focus is laid on grammar and vocabulary. In addition, the students are encouraged to read texts which are aimed at developing their comprehension skills.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8010.1. Build competence in grammar for effective communication.
A8010.2. Acquire suitable vocabulary required for achieving communicative competence.
A8010.3. Utilize academic reading skills to comprehend different texts effectively.
A8010.4. Develop effective writing skills for academic purposes.
A8010.5. Demonstrate basic proficiency in professional correspondence.

3. Course Syllabus

'Toasted English' by R.K.Narayan

Vocabulary : Word Formation - Prefixes and Suffixes; Synonyms and Antonyms; Conjunctions

Grammar : Identifying Common Errors in Writing with Reference to Articles and Prepositions

Reading : Techniques for Effective Reading

Writing : Sentence Structures -Use of Phrases and Clauses in Sentences- Types of sentences; Punctuation; Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

'Appro JRD' by Sudha Murthy

Vocabulary : Homophones, Homonyms and Homographs

Grammar : Identifying Common Errors in Writing with reference to Tenses, Noun-pronoun Agreement and Subject-verb Agreement

Reading : Sub-Skills of Reading – Skimming and Scanning

Writing : Essay writing; Precis writing

Lessons from Online Learning' by F.Haider Alvi, Deborah Hurst et al

Vocabulary : Words Often Confused; Idioms

Grammar : Misplaced Modifiers

Reading : Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice

Writing : Letter Writing: Letter of Request, Letter of Inquiry, Letter of Apology, Letter of Complaint.

'Art and Literature' by Abdul Kalam

Vocabulary : Standard Abbreviations in English

Grammar : Redundancies and Clichés in Oral and Written Communication

Reading : Survey, Question, Read, Recite and Review (SQ3R Method)

Writing : Information Transfer; Letter of Application and Resume/CV writing; Email writing- format, style and etiquette.

Chapter entitled 'Go, Kiss the World' by Subroto Bagchi

Vocabulary : Technical Vocabulary and their Usage

Grammar : Identify the errors with reference to Active and Passive Voice; Reported speech

Reading : Reading Comprehension: Exercises for Practice.

Writing : Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

4. Books and Materials

Text Books:

1. English: Language, Context and Culture by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

Reference Books:

1. Raman, Meenakshi and Sharma, Sangeeta, Technical Communication- Principles and Practice, 3rd Edition, Oxford University Press, New Delhi. Print, 2015.
2. Muralikrishna C. and Sunita Mishra, Communication Skills for Engineers, 2nd Edition, Pearson, 2011
3. Ashraf Rizvi M, Effective Technical Communication, 2nd Edition, McGraw Hill Education, 2017
4. Swan, Michael, Practical English Usage, Oxford University Press. Fourth Edition, 2016.
5. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of Functional Language, Grammar and Vocabulary, 2nd Edition, Sage Publications India Pvt. Ltd.

Course Structure

A8102 - Engineering Geology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is an introduction to the basic concepts of engineering geology. It emphasizes on the origin and nature of earth materials and on geologic environments which affects site conditions, engineering designs and waste disposal sites. It stimulates the development of a culture closely linked to environmental protection.

Course Pre/co-requisites

The course has no specific pre-requisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8102.1. Illustrate various properties of the minerals.
A8102.2. Classify the rocks based on their physical properties.
A8102.3. Identify folds, faults, unconformities, and joints associated with geological structures.
A8102.4. Summarize the causes and effects of earthquakes and landslides.
A8102.5. Select dam site based on the geological considerations.

3. Course Syllabus

Introduction: Definition of Geology, Engineering Geology. Importance of geology from Civil Engineering point of view. Importance of physical geology, petrology and structural geology.

Mineralogy: Importance of study of minerals, Different methods of study of minerals. Role of study of physical properties of minerals in the identification of minerals. Study of physical properties of common rock forming minerals and Economic minerals.

Petrology: Geological classification of rocks into igneous, Sedimentary and metamorphic rocks. Dykes and sills, common structures and textures of igneous, Sedimentary and metamorphic rocks, their distinguishing features. Megascopic study of Granite, Dolerite, Basalt, Pegmatite, Laterite, Conglomerate, Sand Stone, Shale, Limestone, Gneiss, Schist, Quartzite,

Marble and Slate.

Structural Geology: Out crop, strike and dip study of common geological structures associating with the rocks such as folds, faults, unconformities, and joints - their important types.

Earthquakes: Earthquakes, their causes and effects, shield areas and seismic belts. Seismic waves, Richter scale, precautions to be taken for building construction in seismic areas. Landslides, their causes and effect, measures to be taken to prevent their occurrence.

Geology of Dams & Reservoirs: Geological Considerations in the selection of a dam site. Analysis of previous dam failures. Factors contributing in the success of a reservoir.

4. Books and Materials

Text Books:

1. Engineering Geology by N. Chennakesavulu, 3rd Edition, Laxmi Publications Pvt. Ltd, 2018.

Reference Books:

1. P.C. Varghese, Engineering Geology for Civil Engineers, 3rd Edition, PHI Learning & private Limited, 2012.
2. K.V.G.K. Gokhale, Principles of Engineering Geology, 3rd Edition, B.S publications, 2010.

Course Structure

A8103 - Applied Mechanics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is an introduction to learning and applying the principles of physics to solve engineering problems. It deals with the laws of mechanics to analyze forces, moments, motion of rigid bodies, locate centroid, centre of gravity, compute moment of inertia of standard and composite sections. This course also explains kinetics and kinematics of rigid bodies, impulse, centroidal motion and plane motion of rigid bodies.

Course Pre/co-requisites

A8006 - Applied Physics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8103.1. Apply the laws of mechanics to evaluate different types of forces and moments acting on a rigid body.
A8103.2. Solve problem of bodies subjected to friction.
A8103.3. Determine centroid and centre of gravity of standard and composite sections.
A8103.4. Evaluate area and mass moment of inertia of standard and composite sections.
A8103.5. Utilise principles of kinematics and kinetics to solve numerical problems.

3. Course Syllabus

Introduction to Engineering Mechanics: Introduction to Engineering Mechanics–Basic Concepts - Principle of Transmissibility of forces - Resultants of Force System: Parallelogram law – Law of Parallelogram of Forces - Forces and components- Resultant of coplanar Concurrent Forces- Lami's theorem – Moment of Force – principle of moments – Coplanar Applications – Couple – characteristics of couple. Equilibrium of Force Systems: Free Body Diagrams, Equations of Equilibrium.

Friction: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Ladder friction, wedge friction.

Centroid and Centre of Gravity: Centroid and Centre of Gravity, Centroid of simple figures from first principle, centroid of composite sections, Pappus's Centroid Theorem. Centre of Gravity and its implications, centre of gravity of composite sections.

Moment of Inertia: Moment of inertia, Mass moment of inertia, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections. Mass moment of inertia of composite bodies.

Dynamics of Rigid Bodies: Types of motion, Work Energy Equation - Conservation of energy, Impulse and Momentum principle-direct central collisions-coefficient of restitution. D'Alembert's principle.

4. Books and Materials

Text Books:

1. A. K. Tayal, Engineering Mechanics Statics and Dynamics, 14th Edition, Laxmi Publications, 2016.
2. S.S. Bhavikati & K.G. Rajasekharappa, Engineering Mechanics, 5th Edition, India: New age publications,2015.

Reference Books:

1. Timoshenko S.P and Young D.H., Engineering Mechanics, 5th Edition, McGraw Hill International, 1983.
2. R.C. Hibbler, Engineering Mechanics, 12th Edition, New Jersey: Prentice Hall, 2009.

Course Structure

A8009 - Engineering Chemistry Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

The Chemistry Laboratory conducts fundamental studies of highway materials to understand mechanisms. It provides students with a practical approach towards the various techniques used in engineering application. Practical awareness is inculcated and students are trained both quantitatively and qualitatively during the lab sessions to enhance their understanding and problem solving abilities.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8009.1. Apply the instrumental techniques to find out the concentrations or equivalence points of solutions.

A8009.2. Analyze the impurities present in the water using volumetric analysis.

A8009.3. Make use of different titrations to measure various properties of chemical species.

A8009.4. Analyze the importance of temperature and pressure on physical properties like viscosity and surface tension of liquids.

A8009.5. Calculate the yield of synthetic drugs by maintaining specific reaction conditions.

3. List of Experiments

1. Estimation of amount of ferrous ion in a given solution by permanganometry.
2. Estimation of amount of ferrous ion in given solution by dichrometry.
3. Estimation of hardness of water by complexometry using EDTA.
4. Determination of chloride content in water by argentometry.
5. Estimation of amount of hydrochloric acid in a given sample by conductometry.
6. Estimation of amount of acetic acid in a given sample by conductometry.

7. Estimation of amount of hydrochloric acid in a given sample by potentiometry.
8. Estimation of amount of Fe^{+2} in a given sample by potentiometry.
9. Estimation of Mn^{+2} in a given sample by colorimetry.
10. Estimation of Cu^{+2} in a given sample by colorimetry.
11. Determination of viscosity of a given fluid by Ostwald's viscometer.
12. Determination of surface tension of a given liquid by using stalagmometer.
13. Preparation of Aspirin.
14. Preparation of Nylon 6

4. Laboratory Equipment/Software/Tools Required

1. Digital Conductometer
2. Digital Potentiometer
3. Digital Colorimeter
4. Electrical Water Heater
5. Wall Mount Distillation Plant
6. Analytical/Digital Weighing Balance
7. Ostwald's Viscometer
8. Stalagmometer
9. Stopwatch
10. Thermometer
11. RB Flask condenser
12. Magnetic Stirrer
13. Pipette
14. Burette
15. Beaker

5. Books and Materials

Text Books:

1. Ramadevi. B and Aparna. P, Lab manual for Engineering chemistry, S Chand Publications, New Delhi, 2022.

Reference Books:

1. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
2. Ahluwalia. V.K, College Practical Chemistry, Narosa Publications Ltd. New Delhi, 2007.

Course Structure

A8011 - English Language and Communication Skills Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course is designed to cater to the needs of students in developing their oral communication skills. It begins with an introduction to Phonetics to make them understand the received pronunciation and to help them speak with neutral accent and appropriate intonation. This course incorporates listening skills and draws exercises of listening comprehension from various general and business contexts. The speaking exercises in this course will help the students to present their ideas in different situations, besides helping them to develop team spirit by participating in pair/ group activities.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8011.1. Acquire the received pronunciation and speak in a neutral accent.
A8011.2. Use contextual vocabulary for lucid spoken communication.
A8011.3. Comprehend accent of different varieties of English.
A8011.4. Develop skills for professional presentations.
A8011.5. Demonstrate the ability to communicate by enhancing listening skills

3. Course Syllabus

CALL Lab: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening; Introduction to Phonetics – Speech Sounds – Vowels and Consonants
ICS Lab: Spoken vs. Written language- Formal and Informal English; Ice-Breaking Activity and JAM Session- Self Introduction, Importance of Non Verbal Communication; Situational Dialogues: Introducing Others – Greetings – Taking Leave.

CALL Lab: Past Tense and Plural Marker Rules, Structure of Syllables; Listening to Monologues and Dialogues

ICS Lab: Pair Activity: Asking and giving directions; Exchanging information, Making Requests and Seeking Permissions and Justifying Opinions.

CALL Lab: Stress pattern in sentences; Weak and Strong Forms; Neutralization of Mother Tongue Interference; Listening to Group Conversation
ICS Lab: Describing Place, Person and Event

CALL Lab: Intonation; Listening for Specific Information
ICS Lab: Group activity: Agreeing and/or disagreeing, Suggesting, Speculating, Comparing and contrasting; Telephone Etiquette; Introduction to Group Discussion

CALL Lab: Differences between British and American Pronunciation; Listening for General Comprehension of the Content
ICS Lab: Introduction to Interview Skills; Mock Interviews; Structured Presentations; Extempore Presentations

4. Books and Materials

Reference Books:

1. Brook-Hart, Guy, Cambridge English Business Benchmark- Upper Intermediate Business Vantage (with CD), 2nd Edition, South Asian Edition, Cambridge University Press, 2019.
2. Hancock, M., English Pronunciation in Use Intermediate, Cambridge University Press. Print, Cambridge, 2009.
3. Mohanraj, J., Let Us Hear Them Speak, 1st Edition, Sage Texts Print, New Delhi, 2015
4. Exercises in Spoken English, Parts I-III CIEFL, Oxford University Press, 1997.

Course Structure

A8104 - Engineering Geology Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course emphasizes on the study of various types of rock formation and its physical properties. Topics such as rocks and minerals, soils, and earthquake activities are discussed with special reference to local geological problems. This lab course also focuses on physical properties of minerals.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8104.1. Identify various minerals and their properties.
A8104.2. Understand the different types of minerals used in the industries.
A8104.3. Classify rocks using basic geologic classification systems.
A8104.4. Interpret various Geological maps.
A8104.5. Solve Structural Geology problems.

3. List of Experiments

1. Study of Physical properties and description of Minerals.
2. Study of physical properties and identification of rock forming minerals.
3. Study of physical properties and identification of economic minerals.
4. Megascopic description and identification of igneous rocks.
5. Megascopic description and identification of sedimentary rocks.
6. Megascopic description and identification of metamorphic rocks.
7. Study of geological maps.
8. Simple Structural Geology problems.
9. Simple strike and Dip problems.
10. Interpretation and drawing of sections from geological maps showing tilted beds, faults, unconformities etc.

4. Laboratory Equipment/Software/Tools Required

1. Rock forming Minerals
2. Economic Minerals
3. Igneous rocks
4. Sedimentary rocks
5. Metamorphic rocks
6. Geological Maps

Course Structure

A8508 - Python Programming Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

As an introductory course common to all branches, the student will be able to learn problem solving skills using 'PYTHON' programming language, which is a pre-requisite to learn many other programming Languages. The purpose of this course is to provide the basic programming methodology in Python. This course will enable the students to learn programming skills necessary to implement all the basic mathematical, scientific and real world applications. Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. This course will give the foundation for a beginner to develop computer programmes effectively.

Course Pre/co-requisites

A8502 - Problem Solving through C Laboratory

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8508.1. Use expressions and control statements for solving a given problem.
A8508.2. Build programs on sequence of characters using string operations and built in functions.
A8508.3. Implement fundamental data structures for manipulating data.
A8508.4. Build user defined functions and modules to improve code reusability.

3. Course Syllabus

Introduction to Python Programming: Introduction to Python, Features of Python, Identifiers, Reserved Words, Data Types, Variables and Constants, Input / Output Statements, Type Casting, Operators, Operator Precedence and Associativity, Expressions Evaluation.

Control Statements: Conditional Statements –if, if-else, if-elif-else. Iterative Statements –for, while. Jump / Transfer Statements –break, continue, pass.

Strings and Operations: String definition, Slicing, Mathematical Operations on Strings, Checking Membership, Comparison, Formatting Strings, Built in Functions and Methods.

Data Structures and Operations: Sequence, Lists, Tuple, Set and Dictionary – Definition, operations and functions.

Functions and Modules: Introduction, Function Definition, Function call, Type of Arguments, Return Statement, Recursive Functions, Lambda function, Range, Modules.

4. List of Experiments

1. Introduction to Python Lab : Installation and Simple Output Display.
   a) Write a python program to read a string "Python Programming" and display it on the screen.
   b) Write a python program to read integer, float & string values and display them on the screen..
2. Programs using Input Output Statements, Variables and Expressions.
   a) Write a python program to read a float value and convert Fahrenheit to Centigrade.
   b) Write a python program to find the area of triangle.
   c) Write a python program to read the Marks in 4 Subjects and Display the average. .
3. Programs using various operators in Python.
   a) Write a python program for demonstrating the usage of comparison operators
   b) Write a python program to swap / interchange two numbers.
   c) Write a python program for demonstrating the usage of unary, shift, logical, membership and identity operators. .
4. Programs using Conditional Statements.
   a) Write a python program to check a given number is Even or Odd.
   b) Write a python program to find the greatest of 3 integer numbers.
   c) Write a python program to demonstrate nested if statement.
5. Programs using Iterative Statements.
   a) Write a Python program to reverse the digits of a given number.
   b) Write a Python program to find the factorial of a given number.
   c) Write a python program to display factors of a given integer number.
6. Programs using Iterative Statements.
   a) Write a python program to print Fibonacci numbers.
   b) Write a python program to display all prime numbers between 0 to n.
7. Programs using Strings and Its Operations. Write a program that asks the user to enter a string and perform the following:
   i) The total number of characters in the string.
   ii) Repeat the string 10 times.
   iii) The first character of the string. iv) The first three characters of the string.
   v) The last three characters of the string. vi) The string in backwards.
   vii) The seventh character of the string if exist otherwise display a message "Not exist".
   viii) The string with its first and last characters removed.

ix) The string into capital case. x) The string with everya replaced with ane.
xi) The string with every letter replaced by a space.

8. Programs using Python Data Structures (Lists).Write a Python program to perform following operations on a list of integers.
   i) Print the total number of items in the list.
   ii) Print the last item in the list. iii) Print the list in reverse order.
   iv) Print Yes if the list contains a 5 and No otherwise.
   v) Print the number of occurrences of a element in the list.
   vi) Remove the first and last items from the list and sort the remaining items.
   vii) Print how many integers in the list is less than a given value.
   viii) Print the average of the elements in the list.
   ix) Print the largest and smallest value in the list.
9. Programs using Python Data Structures (Dictionary).
   a) Write a python program for demonstrating the creation of dictionary, accessing dictionary elements, modifying dictionary elements, finding length and possible operations.
   b) Write a python program to create a dictionary of students with keys as roll numbers and values as names. Perform operations like insert, update and modify student data.
10. Programs using Python Data Structures (Tuples and Set).
    a) Write a python program to demonstrate various operations on tuples.
    b) Write a python program to demonstrate various operations on sets. .
11. Programs using User Defined Functions.
    a) Write a python program to find factorial of a given number using function.
    b) Write a python program to find factorial of a given number using Recursive function.
12. Programs using Modules.
    a) Write a Python program to display the date and time using the Time module.
    b) Write a Python program that prints the calendar of a particular month.

5. Laboratory Equipment/Software/Tools Required

1. Computer Systems (PCs) installed with Ubuntu OS (Open source/ Freeware)
2. Python and Python IDE (Open Source/ Freeware)

6. Books and Materials

Text Books:

1. Reema Thareja., Python Programming using Problem solving Approach. Oxford University Press, New Delhi India, 2017.

Reference Books:

1. Timothy A Budd. Exploring Python, Tata McGraw Hill Education Private Limited. New Delhi India, 2011.
2. Mark Lutz., Learning Python,5th Edition,O'Reilly, USA, 2015.

Course Structure

A8022 - Engineering Exploration

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This Course provides an opportunity for freshman students to learn in new ecosystem and is one of the unique outcomes of innovative education ecosystem in digital era of our nation. The focus of this course is on Engineering Design Process, Problem Solving, Multi-disciplinary skills, Ethics and Data Acquisition and Analysis. This course is co-designed and co-taught by faculty members drawn from multiple engineering disciplines; it follows Project Based Learning (PBL) pedagogy with need statements covering broad themes of environmental, educational, smart appliances, smart agriculture, industrial needs etc. are used by students to carve out problem definitions by linking Sustainable Development Goals defined by United Nation. Students work in teams to solve identified problems and serves as a platform for peer learning and push students in Multi-disciplinary design thinking in first year itself.

Course Pre/co-requisites

A8021 - Social Innovation

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8022.1 Compare and contrast the contributions of different types of engineers in the development of a product, process, or system.

A8022.2 Apply the common engineering design process to solve complex problems and arrive at viable solution.

A8022.3 Explore various contemporary software and hardware tools to provide solutions for the problems.

A8022.4 Apply skills needed for successful teamwork including the basics of project management and written and oral communication.

A8022.5 Identify the key elements of professional codes of ethics as well as the ethical and societal issues related to the disciplines and their impact on society and the world.

3. Course Syllabus

Introduction to Engineering and Engineering Study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, Expectation for the 21st century engineer and Graduate Attributes.

Engineering Design Process: Design Cycle, Multidisciplinary facet of design, Importance of analysis in engineering design, general analysis procedure, generation of multiple solution, decision matrix, Concepts of reverse engineering and general mechatronics system.

Introduction to Open-source Platforms: Open-source hardware & software tools, Development (Arduino) of Programming (Tinker CAD Tools) and its Essentials, Introduction to Sensors, Transducers and Actuators and its Interfacing with Open-Source H/W & S/W tools.

Engineering Ethics: Identifying Engineering as a Profession, Significance of Professional Ethics, Code of Conduct for Engineers. Sustainability: Introduction to sustainability, Sustainability leadership, Life cycle assessment.

Project Management & Tools: Introduction, Significance of teamwork, Importance of communication in engineering profession, Checklist, Timeline, Gantt Chart, Significance of documentation.

4. Laboratory Equipment/Software/Tools Required

1. Open-source Hardware: Microchip ATmega328P (UNO/NANO/MEGA).
2. I/O Peripherals: LCD, Keypad, DC/Servo Motor, Switch, 7-Segment LED modules, GSM, GPS etc.
3. Sensor Tool Kit:Digital RED/WHITE/GREEN/BLUE Light Module, IR, Analog Sound, Soil Moisture, LM35 Analog Linear Temperature, MQ7 Analog Carbon Monoxide etc.
4. Open-source Software: Arduino IDE Version 1.8.5.

5. Books and Materials

Text Books:

1. Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, Exploring Engineering: An Introduction to Engineering and Design, Academic Press, 3rd Edition, 2012.
2. Byron Francis, Arduino: The Complete Beginner's Guide, Create space Independent Publishers, 2016.

3. M. Govindarajan, S. Natarajan & V. S. Senthil Kumar, Engineering Ethics, 1st Edition, Phi Learning, 2009.

Reference Books:

1. Neerparaj Rai, Arduino Projects for Engineers, 1st Edition, BPB Publications, 2016.
2. Simon Monk, Programming Arduino: Getting Started with Sketches, 2nd Edition, McGraw-Hill Education, 2016.
3. W. Richard Bowen, Engineering Ethics – Outline of an aspirational approach, Springer London.

II YEAR I SEMESTER

Course Structure

A8003 - Probability Distributions and Statistics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides a solid undergraduate foundation in both probability distributions and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in the field of multidisciplinary engineering applications. The mathematical skills sustained from this course form a suitable base to analytical and theoretical concepts encountered in engineering profession.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8003.1. Identify an appropriate probability distribution for a given discrete or continuous random variable and compute probabilities .

A8003.2. Make use of probability distributions to analyze and solve a given problem.

A8003.3. Interpret correlation coefficient in context and study regression analysis and apply the least square errors method numerically and algebraically to find the curve of best fit.

A8003.4. Inspect scientific hypothesis and estimate confidence intervals at different levels.

A8003.5. Compute P-value of a test statistics using component of hypothesis test.

3. Course Syllabus

Random Variables: Discrete and Continuous random variables, Discrete Probability, Distributions, Continuous Probability Distributions, Mean and Variance of Random Variables.

Probability Distributions: Discrete distributions: Binomial distribution, Poisson distribution. Continuous distribution: Uniform distribution, Normal distribution, areas under

the Normal Curve, applications of the Normal Distribution.

Correlation and Regression: Scatter diagram, Positive and Negative correlation, limits for coefficient of Correlation, Karl Pearson's coefficient of correlation, Spearman's Rank correlation, Regression Analysis-: Concept, two lines of regression, Properties of regression coefficients.
Curve Fitting: Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of the form by the method of least squares.

Estimation and Testing of Hypothesis for Large samples: Point estimation, Maximum error estimate, Interval Estimation, Introduction to Hypothesis, Level of significance, one tailed and two tailed test, Test concerning one mean and one proportion, Two means and two Proportions.

Testing of Hypothesis for Small samples: Test for single mean, difference of means and paired t-test, Test for ratio of variances (F-test), Chi-square test for goodness of fit and independence of attributes.

4. Books and Materials

Text Books:

1. Gupta,S.C. and Kapoor,V. K.Fundamentals of Mathematical statistics, 10^{th} Revised Edition, S Chand & Sons, New Delhi, 2000.
2. Grewal, B.S. Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publications, 2015.

Reference Books:

1. T.T. Soong, Fundamentals of Probability and Statistics For Engineers, John Wiley & Sons, Ltd, 2004.
2. Miller and Freund's, Probability and Statistics for Engineers, 8^{th} Edition, Pearson Educations
3. Iyengar, T.K.V. Probability and Statistics, S Chand Publications, 2015.

Course Structure

A8105 - Building Construction and Planning

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course helps students understand the terminology, materials, components and standard dimensions of a building. It covers building bye laws which plays vital role in planning of a building. It also deals with the various components of the buildings as well as planning of various buildings. This course forms basis for advance courses like Construction Project Management.

Course Pre/co-requisites

The course has no specific pre-requisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8105.1. Identify different masonry construction.
A8105.2. Explain building components.
A8105.3. Interpret building bye-laws and principles of planning.
A8105.4. Develop plans for different types of buildings.
A8105.5. Summarize service and safety requirements of the building.

3. Course Syllabus

Masonry: Definition and terms used in masonry. Brick masonry, characteristics and requirements of good brick masonry, Bonds in brick work, Header, Stretcher, English, Flemish bond, Stone masonry, Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Types of walls; load bearing, partition walls, cavity walls.

Building Components: Lintels, Arches, and stair cases. Coupled Roof, Collar Roofs, King and Queen Post Trusses. Panelled and glazed door, glazed and Panelled windows.
Formwork and Finishings: Form work, Under Pinning and scaffolding. Damp proofing, Plastering, Pointing, White washing, Painting, Constituents of paint, Types of paints, Painting of old Wood and Varnish.

Building Byelaws and Regulations: Introduction, Terminology, Principles of Planning, Objectives of building byelaws, Floor area ratio (FAR) and Floor space Index (FSI), Principles underlying building byelaws, Open spaces requirement, built up area limitations, Height of Buildings, Wall thickness, lighting and ventilation requirement.

Building Planning: Site selection for residential and commercial building construction, Orientation of building, Classification of buildings, characteristics of various types of residential buildings, Planning and requirements of educational institutions, hospitals, Office buildings, Cinema hall and hotels.

Service and Safety requirements of Buildings: Damping causes, its effects, and Proofing techniques; Fire hazards, protection, and grading rules; Methods of thermal insulation and materials used.

4. Books and Materials

Text Books:

1. Dr. N. Kumaraswamy & A. Kameswara Rao, Building Planning and Drawing, Charotar Publishing House Pvt Ltd, New Delhi, India, 9th Edition 2019 (Revised & Enlarged).
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Building Construction, Laxmi Publications (P) ltd., New Delhi, India, 11th Edition, 2019.

Reference Books:

1. SP 7: 2016 National Building Code of India 2016.

Course Structure

A8106 - Strength of Materials - I

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course primarily deals with the internal resistance mechanism of material when it is subjected to external loading. This course begins with simple stresses and strains; and relationship between elastic properties of materials. Then it covers the shear force and bending moment diagrams for different support conditions under different loading conditions. Later, it deals with flexural stress, shear stress, and deflection of the beams; and principal stresses in bars.

Course Pre/co-requisites

A8103 - Applied Mechanics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8106.1. Explain concepts and principles related to the strength of materials.
A8106.2. Develop shear force and bending moment diagrams of beams for different support conditions.
A8106.3. Apply theory of simple bending on various sections.
A8106.4. Analyse slope and deflection of beams using different methodss.
A8106.5. Estimate the principal stresses using analytical and graphical methods.

3. Course Syllabus

Simple Stresses and Strains: Concept of stress and strain - St. Venant's Principle-Stress and Strain Diagram – Elasticity and plasticity – Types of stresses and strains- Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli, Elastic constants and the relationship between them – Bars of varying section – composite bars – Temperature stresses.
Strain Energy: Resilience – Gradual, sudden, and impact loadings – simple applications.

Shear Force and Bending Moment: SFD and BMD for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L, uniformly varying loads, Point of

contraflexure, Relation between S.F., B.M and rate of loading at a section of a beam.

Theory of Simple Bending: Theory of simple bending – Assumptions – Derivation of bending equation – Section Modulus – Determination of flexural/bending stresses of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections. **Shear Stresses:** Derivation of formula for shear stress distribution – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle and channel sections.

Slope and Deflection: Slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L., Uniformly varying load – Mohr's theorems – Moment area method – Application to simple cases.

Principal Stresses: Introduction – Stresses on an oblique plane of a bar under axial loading – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Principal stresses – Mohr's circle of stresses – Analytical and graphical solutions.

4. Books and Materials

Text Books:

1. Bansal, R. K. A textbook of strength of materials, 6th Edition, Laxmi Publishers, Hyderabad, 2015.
2. Prakash Rao, Introduction to strength of materials, University press, New Delhi, 2009.

Reference Books:

1. Beer, F.P., Johuston, Jr., E.R., Dewolf, J.T. and Mazureu, D.E., Mechanics of Materials, 5th Edition, McGraw Hill, 2009.
2. Shames, Introduction to solid mechanics, 3rd Edition, PHI New Delhi publications, 2009.
3. Khazimi, S. M, Solid Mechanics, 1st Edition, TMH New Delhi Publications, 2009.

Course Structure
A8107 - Surveying

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course offers to undergraduate students to understand the principles of surveying and levelling. This course introduces the field techniques, instrumentation, measurement of horizontal & vertical distances of inaccessible objects, area using modern equipment. This course includes preparation of plans by utilizing available data of field. This course also discusses the modern equipment like Total station, Electronic theodolite.

Course Pre/co-requisites

The course has no specific pre-requisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8107.1. Apply the principles of surveying in chain surveying and calculating areas and volumes.
A8107.2. Estimate heights and distances by compass surveying and levelling.
A8107.3. Evaluate horizontal and vertical angles by theodolite, and stadia constants by tacheometer.
A8107.4. Utilize geometric and trigonometric principles in calculation of heights and distances.
A8107.5. Make use of advanced surveying instruments in engineering works.

3. Course Syllabus

Introduction: Introduction to surveying – objectives – classification – principles of surveying.

Chain Surveying: Introduction to Chain surveying – Instruments for chaining – obstacles in chaining – Traversing plotting – errors, corrections in chaining – problems.

Areas and Volumes: Calculation of areas and volumes – field notes and plans – Earthwork – Capacity of Reservoirs – Alignment of Hill roads.

Compass Surveying: Introduction to compass surveying – Types of compasses – Designation of bearings – Calculation of included angles from bearings – Traversing – Local

attraction – Errors and corrections – problems.

Levelling: Introduction to Levelling – Types of levelling – Bench mark – Temporary and permanent adjustments – Reduction and arithmetic checks - Height of instrument method – Rise and fall method – Fly levelling – longitudinal levelling – Cross-sectional levelling – plotting – Errors.

Theodolite and Tacheometer: Temporary and permanent adjustments of theodolite, Measurement of horizontal angle - Method of repetition and reiteration - Measurement of vertical angle - Principle of tachometry - Determination of stadia constants.

Trigonometric Levelling: Heights and distances of accessible and inaccessible objects - Instrument and object are in same and different vertical planes.

Curves: Types of curves - Elements of simple curves - Methods of setting simple curves - Rankine's method - Two theodolite method.

Introduction to Advanced Surveying: Total station – introduction – Application – Component parts – Accessories used – Features – characteristics – Electronic Display and data reading – Instrument preparation, setting and measurement- Distance, angle and bearing etc. field procedure for co-ordinate measurement.

Introduction to Electronic Theodolite, Remote Sensing, Global Positioning system (GPS), and Geographic Information System (GIS).

4. Books and Materials

Text Books:

1. R. Subramanian, Surveying and Levelling, 2nd Edition, Oxford University Press, 2012.
2. A. M. Chandra, Higher Surveying, 3rd Edition, New Age International Publishers, 2015.

Reference Books:

1. Satheesh Gopi, R. Sathikumar and N. Madhu, Advanced Surveying: Total station, GPS, GIS and Remote sensing 2nd Edition, Pearson Education in South Asia, New Delhi, 2017.
2. Dr. B.C. Punmia, Er. Ashok K. Jain and Dr. Arun K. Jain., "Surveying, Vol-I & II", 16th Edition, Laxmi Publications Pvt. Ltd, New Delhi, 2017.
3. K. R. Arora, Surveying, Vol. II, 13th Edition, Standard Book House, Delhi, 2013.

Course Structure

A8108 - Fluid Mechanics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Fluid mechanics is the fundamental course of Civil Engineering, which deals with fluid's mechanical principles and applications with mathematical descriptions. The course is useful in understanding and providing solutions to many scientific and technological problems including chemical and industrial processes of mechanical systems. The course covers fluid statics (fluids at rest), fluid kinematics (fluids in motion) and fluid dynamics (effect of forces on fluid motion). After completion of the course, the students will understand the principles of Fluid Mechanics and will be able to apply, analyze and evaluate fluid mechanical systems.

Course Pre/co-requisites

The course has no specific pre-requisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8108.1. Outline the properties of fluids and pressures associated with fluids.
A8108.2. Interpret key concepts of fluid kinematics and dynamics to solve problems in a fluid flow.
A8108.3. Apply Bernoulli's equation to study flow measurements in pipes, notches, and weirs.
A8108.4. Examine flows and losses through pipes.
A8108.5. Analyze the boundary layer effect on the laws of fluid.

3. Course Syllabus

Properties of Fluids: Introduction to fluids, distinction between a fluid and solid, Properties of fluids-mass density, weight density, specific gravity, specific volume, viscosity, boiling point, compressibility and bulk modulus, surface tension, capillarity, vapour pressure, cavitation, and their influences on fluid motion, Classification of fluids: Newtonian and Non-Newtonian fluids, Newton's law of Viscosity and applications.

Fluid Statics: Concept of pressure - atmospheric, gauge and vacuum pressure. Concept of free surface. Fluid pressure at a point, Pascal's law, pressure variation in a fluid at rest, Hydrostatic law. Total pressure and center of pressure, Hydrostatic forces on submerged planes -

Horizontal, Vertical, inclined and curved surfaces, Principle of Buoyancy-metacentric height, conditions of Equilibrium.
Pressure Measurement: Measurement of Pressure-simple Manometers, differential Manometers.

Fluid Kinematics: Classification of fluid flows: Steady-Unsteady, Uniform-Non uniform, Laminar-Turbulent, Rotational - Irrotational flows, one, two, and three-dimensional flows. Methods of Describing fluid motion - Eulerian and Lagrangian approach. Streamline, path line, streak lines and stream tube. Equation of continuity for one, two, and three-dimensional flows, velocity and acceleration functions. Stream function and Velocity Potential Functions, Flow Net Analysis.
Fluid Dynamics: Surface and body forces - Euler's and Bernoulli's equations for flow along a stream line. Momentum equation. Correction factors. Bernoulli's equation to real fluid flows.

Flow Measurement in Pipes: Practical applications of Bernoulli's equation - Pitot tube, Venturi- meter and orifice meter, applications of Momentum equations. Forces exerted by fluid flow on pipe bend, sudden enlargement in pipes.
Notches and Weirs: Classification of Notches and Weirs. Discharge over rectangular, triangular, and trapezoidal notches and weirs. Velocity of Approach. Discharge over a Broad crested weir.

Flow Through Pipes: Introduction, Reynolds experiment - Characteristics of Laminar & Turbulent flows. Reynolds number. Loss of head through pipes-major, minor losses. Darcy-Weisbach equation. Total Energy Line and Hydraulic Gradient Line. Pipes in series, pipes in parallel. Equivalent pipe concept. Flow through branched pipes. Three reservoir problem. Analysis of pipe networks: Hardy Cross method and EPA NET. Water hammer in pipes and control measures.

Laminar and Turbulent Flow: Laminar flow through circular pipes and fixed parallel plates.
Boundary Layer Theory: Introduction, Definitions. Prandtl contribution, Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum and energy thickness concepts of laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control. Drag and Lift. Types of drag. Magnus effect.

4. Books and Materials

Text Books:

1. R.K. Bansal, Fluid Mechanics and Hydraulic Machines, 10th Edition, Laxmi Publications (P). Ltd, 2018.

Reference Books:

1. Modi and Seth, Fluid Mechanics, 22nd Edition, Standard book house, 2012.
2. K. Subramanya, Fluid Mechanics and Hydraulic Machines, 1st Edition, McGraw Hill Education, 2019.

Course Structure

A8109 - Strength of Materials Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course primarily deals with determination of mechanical properties such as tensile, compressive, impact, shear strength and hardness of the material which is helpful for the design of structures and its applications. Selection of the material for structural application is a difficult task. This course will be helpful to select a proper material for structural applications. This course also supplements the theoretical knowledge gained in strength of materials with practical testing for determining different strengths of materials under various loading conditions.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8109.1. Evaluate properties of the material by tensile test.
A8109.2. Determine compressive and flexural strength of materials.
A8109.3. Analyse properties of material by impact test.
A8109.4. Estimate properties of the material by using hardness test.
A8109.5. Make use of strain gauges and find the strain for a material.

3. List of Experiments

1. Tension test (Stress-strain curve for mild steel)
2. Compression test on brick / wood / concrete
3. Bending test on simply supported beam
4. Bending test on cantilever beam
5. Verification of Maxwell's Reciprocal theorem on beams
6. Continuous beam - deflection test
7. Hardness test
8. Impact test
9. Shear test

10. Usage of strain gauges
11. Helical spring test

4. Laboratory Equipment/Software/Tools Required

1. Universal testing machine
2. Compression testing machine
3. Brinell hardness testing machine
4. Impact testing machine
5. Shear testing machine
6. Strain gauge apparatus
7. Deflection of beam apparatus (simply supported, cantilever and continuous)
8. Spring testing machine

Course Structure

A8110 - Surveying Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course is offered to undergraduate students to deal with the principles of surveying and levelling. This course demonstrates measurement of angles, distances, levels of accessible and inaccessible objects. This course also includes identification of errors and application of corrections to prepare plan of a particular area.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8110.1. Demonstrate the use of basic surveying tools.
A8110.2. Identify types & sources of errors in all basic surveying tools.
A8110.3. Interpret survey data and compute areas.
A8110.4. Determine the location and levels of points on field & plotting using various methods.
A8110.5. Measure horizontal and vertical angles using theodolite.

3. List of Experiments

1. Survey of an area by chain survey (closed traverse) & Plotting
2. Chaining across obstacles
3. Determination of distance between two inaccessible points with compass.
4. Survey of given area by using prismatic compass
5. Radiation and intersection method by using plane table
6. Determination of elevation difference between two points using fly leveling
7. Plot the longitudinal profile of a given stretch
8. Plot the cross sections of a given stretch
9. Two exercises on Contouring
10. Study of theodolite in detail - practice for measurement of horizontal and vertical angles
11. Measurement of horizontal angles by method of repetition and reiteration

4. Laboratory Equipment/Software/Tools Required

1. 20m/30m chains
2. Arrows
3. Tapes
4. Ranging Rods
5. Cross staffs
6. Prismatic compass
7. Plane table apparatus
8. Auto level
9. Levelling staff
10. Theodolite

Course Structure

A8111 - Computer Aided Drafting Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course emphasizes on representing the building components using computer aided drafting software. This course helps student to illustrate engineering drawings which are blended with aspects of building planning. The course covers plan, section and elevation views of residential building, office building and their components.

Course Pre/co-requisites

A8101 – Construction Materials

A8105 – Building Construction and Planning

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8111.1. Represent building materials and components.
A8111.2. Plan residential building and represent all the building components.
A8111.3. Illustrate elevation and sectional views of residential building.
A8111.4. Construct plan, elevation and sectional views of public building.
A8111.5. Develop electrical and plumbing layout for buildings.

3. List of Experiments

1. Developing plan of doors and windows.
2. Developing plan and section of dog-legged staircase.
3. Developing plan of column and footing markings.
4. Develop
   a) Plan of residential building.
   b) Section and Elevation of residential building.
5. Develop
   a) Plan of Educational building
   b) Section and Elevation of Educational building
6. Develop
   a) Electrical Layout.

b) Plumbing Layout

4. Laboratory Equipment/Software/Tools Required

1. AutoCAD Software
2. Computer PCs

Course Structure

A8023 - Engineering Design Thinking

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course links the primary fields of engineering, explores the engineering design process from conceptual design and optimal choice evaluation to prototyping for project construction. It also provides insights into particular design challenges within their specific fields of engineering and enables the learners to apply the knowledge in real time - designing, constructing and testing a prototype (actual physical build) to solve a real-world engineering problems. In extent, this course is an excellent roadmap for the design engineers seeking to broaden their engineering knowledge to design concepts to their current work.

Course Pre/co-requisites

A8021 - Social Innovation

A8022 - Engineering Exploration

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8023.1. Interpret the problem-solving skills and product design skills.
A8023.2. Apply foundational knowledge of the primary fields of engineering and scientific concepts to find sustainable solution.
A8023.3. Customize the HCD model to the traditional engineering design process.
A8023.4. Inspect the design and assess a prototype that solves real engineering problem.
A8023.5. Expound the solutions for identified problems and document the findings/reflections for further design.

3. Course Syllabus

Introduction & Case Studies: Definition of design, design process, different problem types, characteristics of novice and informed designers, enhance negotiation and iteration in design, Recognized organizations for design and innovation, shopping cart case study, benefits of failure in design.

Human Centered Design: Introduction to HCD (Human Centered Design), HCD as a Mindset, personas and scenarios, best practice working with communities.

Development of Specification and prototyping: Definition of specification, three examples of ways to generate specifications, how to manage specifications, functional de- composition, three kinds of prototypes, how prototypes can be used in the design process,how to use prototypes can be used to elicit input from users.

Ideation, Innovation & Creativity in Design: Con- cept Selection, Interpretation of Creativity and Innovation, Brain storming and expanding the design Space, case study using decision matrix.

Design for Robustness: Review the design, Brainstorm potential failure models, List the potential effects of failure & causes for each failure.

4. Laboratory Equipment/Software/Tools Required

1. Computers installed with operating system

5. Books and Materials

Text Books:

1. William C. Oakes, Les L. Leone, and Craig J. Gunn, Engineering Your Future, Okemos, MI: Great Lakes Press, 2004.
2. Crismond, D., Contrasting strategies of beginning and informed designers: One representation of learning progressions in engineering design, 2007.
3. Ryan Jacoby and Diego Rodrigue, Innovation, Growth, and Getting to Where You Want to Go, Design Management Review, Vol. 18 No. 1, Winter, 2007.
4. G.Pahl and W.Beitz, Engineering design: A systematic approach, Springer 2nd Editon.
5. Dean Nieusma, Seeing Social Power: Technology Design for User Empowerment, Great Lakes Press, 2012
6. Avery, C. M., Teamwork is an Individual Skill: Getting Your Work Done When Sharing Responsibility. San Francisco, CA: Berrett-Koehler Publishers, Inc., 2001.
7. Astin, A. W., & Astin, H. S., Leadership reconsidered: Engaging higher education in social change - Battle Creek, MI: W. K. Kellogg Foundation, 2000.

Reference Books:

1. Ali K.Kamrani, Emad Abouel Nasr, Engineering design and Rapid Prototyping, 2nd Edition, Springer, 2010
2. Ken Hurst, Engineering design principles, Elsevier Science, 2nd Edition, 2005.

Course Structure

A8031 - Gender Sensitization

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

Gender Sensitization is a course that introduces students to different dimensions of gender issues. It is one of the basic requirements for the normal development of an individual and primarily highlights the contribution of both the genders in creation and development of a well balanced society. A curriculum-based approach to bring a change is desired to inculcate sensitivity towards issues concerning the relationship between men and women, caste, declining sex ratio, struggles with discrimination, sexual harassment, new forums for justice, eve-teasing, etc., The need for this sensitivity has been felt and realized through times immemorial and in almost all kinds of human existence, across the globe.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8031.1. Interpret gender sensitization and problems of other genders.

A8031.2. Identify the reasons for the female feticide.

A8031.3. Attain a finer grasp of how gender discrimination works in our society and how to counter it.

A8031.4. Develop sensitivity towards sexual and domestic violence.

A8031.5. Recognize gender sensitivity issues through literature and media.

3. Course Syllabus

Understanding Gender: Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men Preparing for Womanhood. Growing up Male. First lessons in Caste.

Gender Roles and Relations: Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles- Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences- Declining Sex Ratio. Demographic Consequences Gender Spectrum: Beyond the Binary.

Gender and Labour: Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. -Gender Development Issues-Gender, Governance and Sustainable Development Gender and Human Rights-Gender and Mainstreaming.

Gender - Based Violence: The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No!-Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu". Domestic Violence: Speaking Out: Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life. . . ."

Gender and Culture: Gender and Film-Gender and Electronic Media Gender and Advertisement Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks- The Brave Heart.

4. Books and Materials

Text Books:

1. Towards a World of Equals: A Bilingual Textbook on Gender". Telugu Akademi, Hyderabad, 2015

Additional Resources:

1. www.worldofequals.org.in

Course Structure

A8033 - Universal Human Values 2: Understanding Harmony

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

Values are individual beliefs that motivate people to act in one way or the other, it has an inherent worth, and it prepares an individual to adapt in the family, community and society. The basic five Human Values: Love, Peace, Truth, Right Conduct and Non-violence are hidden in every human being; they are our candid attributes. These fundamental human values contain mankind's deepest moral aspirations and form the basis of our lives as individuals and as societies. A didactic system based on human values helps in holistic development of students and it aids to their understanding of true happiness which can only be found within, not in the transient outside world. All objects in the world are subjected to change, however, the ideals, virtues and values established in human hearts remain as a perpetual source of inspiration to the humankind. The course is an overview of human values that are universally accepted and it highlights the need to incorporate these values in students so that they can contribute their service to human race fruitfully. It briefly discusses their role in their family, society and nature and sensitises them towards harmonious living.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8033.1. Analyze the process of self-exploration, right understanding, relationships, natural acceptance for achieving ultimate happiness .
A8033.2. Examine human being as a co-existence of self 'I' and the material 'Body'.
A8033.3. Correlate the universal harmonious order in society, undivided society and from family to world family.
A8033.4. Interpret the harmony in nature, holistic perception at all levels of existence.
A8033.5. Analyze professional competence for augmenting universal human order, ethical human conduct for acceptance of human values.

3. Course Syllabus

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, recapitulation from Universal Human Values-1; Self-Exploration what is it? –its content and process; 'Natural Acceptance' and Experiential Validation – as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic human aspiration; Right Understanding, Relationship and Physical facility; Understanding Happiness and Prosperity correctly; Method to fulfill the above Human Aspirations; Understanding and living in harmony at different levels.

Understanding harmony in the Human Being- Harmony in Myself!: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body'-happiness and physical facility; Understanding the body as an instrument of 'I'; Understanding the characteristics and activities of 'I' and harmony 'I'; Understanding the harmony of 'I' with the body: Sanyam and health; Correct appraisal of physical needs, meaning of prosperity in detail; Programs to ensure Sanyam and Health.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship: Understanding values in human-human relationship; meaning of justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness: Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust; difference between intention and competence; Understanding the meaning of respect, Difference between respect and differentiation; the other salient values in relationship; Understanding harmony in the society; Visualizing a universal harmonious order in society.

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence: Understanding the harmony in the Nature; Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural Acceptance of Human Values; Definitiveness of Ethical Human Conduct; Basics for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case studies of typical holistic technologies, management models and productive systems; Strategy for transition from the present state to Universal Human Order.

4. Books and Materials

Text Books:

1. Human values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, 1st Edition, Excel Books, New Delhi, 2010.

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A. N. Tripathi, 3rd Edition New age Intl. Publishers, New Delhi, 2019.
3. The Story of My Experiments with Truth- by Mohandas Karamchand Gandhi, 1st Edition, Fingerprint Publishing, 2009.

II YEAR II SEMESTER

Course Structure

A8013 - Business Economics and Financial Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course addresses the concepts, principles and techniques of Business Economics and Financial Analysis. It covers the fundamentals of Business Economics and its various aspects. Financial analysis gives clear idea about concepts and conventions of accounting, accounting procedures like journal, ledger, trial balance, final accounts and interpretation of financial statements through ratios.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8013.1. Examine the types of business and impact of macroeconomic variables on business.

A8013.2. Analyze interrelationship among various economic variables and its impact.

A8013.3. Classify the market structure to decide the fixation of suitable price.

A8013.4. Apply accounting principles & rules for preparing financial statements.

A8013.5. Analyze financial statements to assess financial health of business.

3. Course Syllabus

Introduction to Business and Economics: Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance. **Economics:** Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist.

Demand and Supply Analysis: Elasticity of Demand: Elasticity, Types of Elasticity, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of

Demand, Law of Demand. Demand Forecasting: Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function and Law of Supply. .

Production, Cost, Market Structures & Pricing: Production Analysis Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.
Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structure: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis (simple problems).

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts (Simple Problems).

Financial Ratios Analysis: Concept of Ratio Analysis, Importance and Types of Ratios-Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

4. Books and Materials

Text Books:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata Mc –Graw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata Mc Graw Hill Education Pvt. Ltd. 2012.

Reference Books:

1. A.R. Aryasri (2011), Managerial Economics and Financial Analysis, TMH, India.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

Course Structure

A8112 - Strength of Materials – II

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is extension to the Strength of Materials - I. The topics covered in the course explains more about complex geometry and loading conditions. It is intended to introduce the basic principles for the design of power transmission shafts, springs, columns and struts, beam-columns, dams, chimneys, retaining walls, unsymmetrical beams, thin and thick cylinders. It also imparts adequate knowledge to continue the design and research activity in structural analysis.

Course Pre/co-requisites

A8103 - Applied Mechanics

A8106 - Strength of Materials - I

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8112.1. Apply classical theories of failures to compute different types of response in the structural elements.

A8112.2. Solve the problems of various structural members subjected to different loading systems.

A8112.3. Analyze cylindrical and spherical shells under different loading conditions.

A8112.4. Determine stresses developed in various structures.

A8112.5. Compute shear centre for different cross-sections.

3. Course Syllabus

Torsion of Circular Shafts: Theory of pure torsion– Assumptions made in the theory of pure torsion – Derivation of Torsion equation – Polar section modulus – Power transmitted by shafts – Combined bending and torsion.

Springs: Introduction, Types of springs, deflection of close and open coiled helical springs under axial pull and axial couple – springs in series and parallel.

Columns and Struts: Introduction, Types of columns – Short, medium and long columns – Axially loaded compression members – Crushing load – Euler's theorem for long columns,

assumptions, Derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column, slenderness ratio, Euler's critical stress, Limitations of Euler's theory, Rankine-Gordon formula – Long columns subjected to eccentric loading.

Beam Columns: Laterally loaded struts – subjected to uniformly distributed and concentrated loads.
Direct and Bending Stresses: Stresses under the combined action of direct loading and bending moment, core of a section – determination of stresses in the case of chimneys.

Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders.
Thick Cylinders: Introduction, Derivation of Lame's formulae, distribution of hoop and radial stresses across thickness – compound cylinders, Necessary difference of radii for shrinkage.

Unsymmetrical Bending: Introduction – Centroidal principal axes of section – Moments of inertia referred to any set of rectangular axes – Stresses in beams subjected to unsymmetrical bending.
Shear Centre: Introduction – Determination of Shear Centre for Channel section and I-section

4. Books and Materials

Text Books:

1. Bansal R. K, "Strength of Materials", Laxmi Publications, 6th Edition, 2018.
2. Dr. B.C. Punmia, Er. Ashok Kumar Jain, Dr. Arun Kumar Jain, "SMST-I Strength of Materials", Laxmi Publications, 10th Edition, 2018.

Reference Books:

1. S. S. Rattan, "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd, 3rd Edition, 2017.
2. R. Subramanian, "Strength of Materials", Oxford University Press, 3rd Edition, 2016.

Course Structure

A8113 - Hydraulics and Hydraulic Machines

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is intended to introduce open channel hydraulics and the working of hydraulic machinery. It covers knowledge regarding various theories dealing with the flow phenomenon of fluid in open channels. The subject introduces the use of dimensional analysis techniques in solving fluid problems and plan hydraulic similitude studies. Major emphasis is given to understand the basics of hydro machinery, its components, function and use of different types of turbines and pumps.

Course Pre/co-requisites

A8108 - Fluid Mechanics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8113.1. Explain the fundamentals of open channel flows.
A8113.2. Demonstrate an understanding of non-uniform channel flow and hydraulic jump.
A8113.3. Evaluate the model and prototype relations by similarity laws and basics of turbomachinery.
A8113.4. Apply the fundamentals of fluid forces to understand the functioning and technical aspects of hydraulic turbines.
A8113.5. Analyze the possible problems, performance and installation techniques of centrifugal pumps.

3. Course Syllabus

Open Channel Flow – I: Open Channel Flow – I: Introduction to Open channel flow-Comparison between open channel flow and pipe flow, Classification of open channel flows, Velocity distribution. Uniform flow – Characteristics of uniform flow, Chezy's, Manning's and Bazin formulae for uniform flow – Factors affecting Manning's Roughness Coefficient. Most economical sections. Computation of Uniform flow, Normal depth. Critical Flow: Specific energy – critical depth - computation of critical depth – critical, sub critical and

super critical flows-Channel transitions.

Open Channel Flow – II: Non-uniform flow – Gradually Varied Flow - Dynamic equation for G.V.F; Classification of channel bottom slopes – Classification and characteristics of Surface profiles – Computation of water surface profiles by Numerical and Analytical approaches. Direct step method.
Rapidly varied flow: Elements and characteristics (Length and Height) of Hydraulic jump in rectangular channel– Types, applications and location of hydraulic jump, Energy dissipation and other uses – Positive and Negative Surges (Theory only).

Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity – Rayleigh's method and Buckingham's π methods – Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problems. Distorted models.
Basics of Turbo Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, Jet striking centrally and at tip, Velocity triangles at inlet and outlet, expressions for work done and efficiency – Angular.

Hydraulic Turbines – I: Elements of a typical Hydropower installation – Heads and efficiencies – Classification of turbines – Pelton wheel – Francis turbine – Kaplan turbine – working, working proportions, velocity diagram, work done and efficiency, hydraulic design. Draft tube – Classification, functions and efficiency.
Hydraulic Turbines – II: Governing of turbines – Surge tanks – Unit and specific turbines – Unit speed – Unit quantity – Unit power – Specific speed – Performance characteristics – Geometric similarity – Cavitation. Selection of turbines.

Centrifugal Pumps: Pump installation details – classification – work done – Manometric head – minimum starting speed – losses and efficiencies – specific speed. Multistage pumps – pumps in parallel – performance of pumps – characteristic curves – NPSH – Cavitation. Reciprocating pumps – Working, discharge, slip indicator diagrams.

4. Books and Materials

Text Books:

1. R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 10th Edition, Laxmi Publications (P) Ltd., 2018.
2. V. T. Chow, Open Channel Hydraulics, 2nd Edition, Blackburn Press, 2009.

Reference Books:

1. Modi and Seth, Fluid Mechanics, 22nd Edition, Standard book house, 2012.
2. K. Subramanya, Fluid Mechanics and Hydraulic Machines, 1st Edition, McGraw Hill Education, 2019.
3. D. S. Kumar, Fluid Mechanics and Fluid Power Engineering, 1st Edition, Kataria and Sons, 2013.

Course Structure

A8114 - Concrete Technology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course mainly deals with preparation and handling of concrete. This course starts by covering properties of concrete constituents and usage of admixtures. Thereafter, it covers the tests on fresh and hardened concrete for field applications. Subsequently, it also covers mix design for different grades and special concretes. This course develops the basic fundamentals for the reinforced concrete design and pre-stressed concrete.

Course Pre/co-requisites

A8105 - Building Construction and Planning

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8114.1. Evaluate properties of concrete manufacturing materials to check their quality.
A8114.2. Classify various types of admixtures and its applications.
A8114.3. Measure properties of fresh and hardened state of concrete.
A8114.4. Design different grades of concrete mixes for various field applications.
A8114.5. Illustrate various types of special concrete and their use.

3. Course Syllabus

Cement: Portland cement- chemical composition- Hydration of cement -Structure of Hydrated cement test on physical properties- Different grades of cement.

Aggregates: Classification of aggregate- Physical and Mechanical Properties of Aggregates-Deleterious substance in aggregate- Soundness of aggregate- Alkali aggregate reaction- Thermal properties of Aggregates-Grading of Aggregates-Sieve Analysis—Standard Grading Curves.

Admixtures: Types of admixtures- mineral and chemical admixtures- properties-dosages-effects - usage.

Fresh Concrete: Workability- Factors affecting workability Measurement of workability by different tests- Setting times of concrete- Effect of time and temperature on workability-Segregation & bleeding Mixing and vibration of concrete- steps in manufacture of concrete-

Quality of mixing water.

Hardened Concrete: Water/cement ratio- Gel space ration- Nature of strength of concrete-Maturity concept- Strength in tension & compression- Factors affecting strength - Relation between compression & tensile strength- Curing of concrete and different methods for curing. **Testing of Hardened Concrete:** Compression tests- Tension tests- Factors affecting strength flexure tests- Split tensile test- Pull-out test, Non-destructive testing methods-Codal provisions for NDT. Creep of concrete - Factors influencing creep- Relation between creep & time- Effects of creep- Shrinkage- types of shrinkage.

Mix Design: Factors, the choice of mix proportions- Durability of Concrete-Quality Control of concrete- Statistical Quality Control- Acceptance criteria- Proportioning of concrete mix by normal by using BIS method and ACI Methods.

Special Concrete: Introduction to Lightweight concrete-No-fines Concrete- Fiber reinforced concrete Polymer concrete- Self-compacting concrete -Geopolymer Concrete-High Performance Concrete.

4. Books and Materials

Text Books:

1. M. S. Shetty, Concrete Technology, S. Chand & Co.,8th Edition, 2006.
2. A.M. Neville, Concrete Technology, Pearson Education Limited, 2nd Edition 2010.

Reference Books:

1. Job Thomas, Concrete Technology, Cengage Learning, 2nd Edition, 2015.
2. M.L. Gambhir, Concrete Technology, Tata McGraw Hill publishers, New Delhi, 5th Edition, 2017.

Course Structure

A8115 - Structural Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course is offered to undergraduate students to deal with determinate and indeterminate structures under various loading conditions. The course introduces the analysis of arches, and suspension cables. This course also discusses Slope deflection method and moment distribution methods for continuous beams and frames. Graphical representation of bending moment and shear force in continuous beams using influence line diagrams is also included.

Course Pre/co-requisites

A8112 - Strength of Materials - II

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8115.1. Classify two hinged arches and indeterminacies.
A8115.2. Solve thrust moments and forces for arches .
A8115.3. Apply energy theorems to plane trusses.
A8115.4. Determine slopes for indeterminate structures.
A8115.5. Evaluate bending moments for indeterminate structures.

3. Course Syllabus

Static and Kinematic Indeterminacy: Determinate and Indeterminate structures –Static and Kinematic indeterminacy ARCHES: Introduction to arches and their classification – Analysis of two hinged parabolic and circular arches.

Energy Theorems: Introduction - Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano's first theorem - Unit load Method. Definitions of simple beams and pin- jointed plane trusses. Definitions of statically determinate bent frames.

Fixed Beams: Analysis of fixed beams with and without varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point

loads, uniformly varying load, couple and combination of loads - Shear force and Bending moment diagrams for Fixed Beams - Effect of rotation of a support - Effect of sinking of supports.

Slope - Deflection Method: Derivation of slope- deflection equation, Application to continuous beams with and without settlement of supports – Analysis of frames - Shear force and bending moment diagrams.

Moment Distribution Method: Introduction – Distribution theorem – Carryover theorem - Application to continuous beams with and without settlement of supports - Analysis of frames - Shear force and bending moment diagrams.

4. Books and Materials

Text Books:

1. S. Ramamrutham, Theory of structures, 9th edition, Dhanpat rai publishing company, 2014.
2. S.S.Bhavikatti, Structural Analysis Vol I & Vol II, 4th edition, Vikas publishing house Pvt. Ltd, 2010.

Reference Books:

1. G.S. Pundit and S.P. Gupta, Structural Analysis Vol I & Vol II, 2nd edition, Tata McGraw Hill Publishers, 2008.
2. C.S. Reddy, Basic Structural Analysis, 3rd edition, Tata McGraw Hill Publishers, 2017.
3. T. S. Thandavamoorthy, Structural Analysis, 1st edition, Oxford university press, 2011.

Course Structure

A8316 - Fluid Mechanics and Hydraulic Machines Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course mainly deals with the behaviour of fluids and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

Course Pre/co-requisites

A8304 - Engineering Mechanics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8316.1. Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
A8316.2. Correlate various flow measuring devices such as Venturimeter and orifice meter.
A8316.3. Discuss the performance characteristics of turbines and pumps.
A8316.4. Analyze the hydrodynamic force of jets on stationary and moving vanes
A8316.5. Estimate energy losses and boundary layer parameters for laminar and turbulent flows.

3. List of Experiments

1. Calibration of Venturi meter
2. Calibration of Orifice meter.
3. Determination of friction factor in a given pipe line.
4. Determination of loss co-efficient due to sudden contraction
5. Verification of Bernoulli's theorem
6. Determination of the nature of flow through a pipe. (Reynold's experiment)
7. Determination of the efficiency of vane using Impact of jet on Vane Setup.
8. Determination of the operating characteristics of Pelton wheel turbine
9. Determination of the operating characteristics of Francis Turbine
10. Determination of the operating characteristics of Kaplan Turbine

11. Determination of the efficiency of Single Stage Centrifugal Pump.
12. Determination of the efficiency of Multi Stage Centrifugal Pump.
13. Determination of the efficiency of Reciprocating Pump

4. Laboratory Equipment/Software/Tools Required

1. Venturimeter and Orifice meter setup
2. Major and Minor Losses in pipes setup
3. Bernoulli's theorem verification setup
4. Reynolds Apparatus
5. Impact of jet on vane setup
6. Pelton turbine test rig
7. Francis turbine test rig
8. Kaplan Turbine test rig
9. Single Stage Centrifugal Pump test rig
10. Multi Stage Centrifugal Pump test rig
11. Reciprocating Pump test rig

Course Structure

A8116 - Concrete Technology Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course covers a wide range of experiments related to examining the various properties of commonly used construction materials including, concrete and its constituents; cement, coarse and fine aggregate, water and admixture. Additionally, other aspects relevant to fresh and hardened concrete are also explored such as mixing, handling, casting (workability), density and mechanical properties. Other tests such as NDT will help to understand and assess the quality of the concrete construction.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8116.1. Assess different physical properties of cement.
A8116.2. Determine different properties of aggregate.
A8116.3. Evaluate fresh concrete by conducting different workability tests.
A8116.4. Examine mechanical properties of the hardened concrete.
A8116.5. Demonstrate non-destructive testing procedures on concrete.

3. List of Experiments

1. Tests on Cement
   (a) Normal Consistency and fineness of cement
   (b) Initial setting time and final setting time of cement
   (c) Specific gravity of cement
   (d) Soundness of cement
   (e) Compressive strength of cement
2. Tests on Aggregate
   (a) Sieve Analysis and gradation charts
   (b) Bulking of sand
   (c) Bulk and compact densities of fine and coarse aggregates

3. Tests on Fresh Concrete
   (a) Slump test
   (b) CF (compact factor test)
   (c) Vee-bee Test
   (d) Flow Table Test
4. Self-Compacting Concrete
   (a) Slump cone
   (b) V funnel
   (c) L Box
   (d) J-Ring
5. Tests on Hardened Concrete
   (a) Compression test on cubes
   (b) Flexure test
   (c) Splitting Tensile Test
6. 6. Non-Destructive Test of Concrete
   (a) Rebound hammer
   (b) Ultrasound pulse Velocity (UPV)

4. Laboratory Equipment/Software/Tools Required

1. Vicat's Apparatus
2. Specific Gravity Bottle
3. Le-Chatelier Mould
4. Le-Chatelier Water Bath
5. Sieve Sets for Fine and Coarse Aggregates
6. Cylindrical metal measures (1L, 3L and 5L)
7. Slump Test Apparatus
8. Compaction Factor Apparatus
9. Vee-Bee Consistometer
10. Self-Compacting test Apparatus (L-Box, J-Ring, V-Funnel and Flow Table)
11. Compression Testing Machine
12. Flexural Testing Machine
13. Rebound Hammer
14. Ultrasonic Pulse Velocity test setup
15. Moulds (cube, cylindrical and flexural)

Course Structure

A8117 - Advanced Surveying Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course gives introduction to advanced instruments like Total station, Electronic theodolite. It includes determination of heights, distances and elevations using trigonometric levelling and principle of tacheometry. This also introduces the assessment of field conditions to select appropriate technique and equipment according to the conditions of a site.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8117.1. Make Use of advanced surveying instruments like electronic theodolite and total station.
A8117.2. Measure angles and distances.
A8117.3. Interpret field notes and survey data.
A8117.4. Determine elevations/heights of various structures.
A8117.5. Establish setting out works like buildings and highways.

3. List of Experiments

1. Trigonometric Levelling - Heights and distance problem
2. Heights and distances using principles of tachometric surveying
3. Measurement of Distance and angles using total station
4. Determination of area using total station
5. Determination of remote height using total station
6. Stakeout using total station
7. Distance and gradient between two inaccessible points using total station
8. Co-ordinates marking using Total station
9. Curve setting using Total station
10. Setting out works for buildings using total station

4. Laboratory Equipment/Software/Tools Required

1. Tapes
2. Ranging Rods
3. Theodolite
4. Total station
5. Electronic Distance Measuring Instrument

Course Structure

A8024 - Product Realization

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Making the students socially responsible is the main motto. In this process introducing technological concepts and creating innovating product is carried out for the community. The Product Realization introduces communication with community, planning of product realization, design and development of the product added with skill sets of leadership. This course given an exposure on converting an innovative idea to physical product to meet the need of the community. It improves skill of research paper writing, patent drafting and also developing the skill of preparation of business models.

Course Pre/co-requisites

A8021 - Social Innovation

A8022 - Engineering Exploration

A8023 - Engineering Design Thinking

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8024.1. Interpret the specifications of product and solve for practical realization.
A8024.2. Analyse the customers mind set and design the product.
A8024.3. Develop Gantt chart to define timeline for product realization.
A8024.4. Conceptualize the terms called product, purchase, production and monitoring of products.
A8024.5. Communicate the process of converting an idea to physical product to the community.

3. Course Syllabus

Theory

Introduction and Planning of Product Realization: Introduction to Product Realization, Need for Product Realization, Product realization process, Case Study of Product Realization for Global Opportunities. Plan and develop the processes needed for product realization, Defining Quality objectives and requirements, establish processes documents.

Needs - verification, validation, monitoring inspection and test activities (inspection nodes) and criteria for product acceptance and record needed. Case study on timeline of Product realization planning (Gantt Chart).

Customer-Related Processes: Product information Enquiries, contracts or order handling Customer feedback including customer complaints, A field survey.

Design and Development: Review verification and validation of each design and development stages, Functional and performance requirements, Information for purchasing, production and service provisions, review and validation, Develop a Design model of the product.

Purchasing, Production and Service Provision: Purchasing information, Vendors evaluation and approval process, Verification of purchased product. Control of production, service provision, validation of processes for production and service provision, Identification and tractability, Customer property and Preservation of product.

Scope of Product Perseverance: Writing proficiency for papers, Patent drafting and development of business model.

Practice

1. Introducing oneself to the steps of Product realization.
2. Case Study to define the necessity.
3. Brainstorming Session on Product Realization in teams.
4. Watching videos on Planning of product realization in real time scenario from R Labs.
5. Verification of the Product specifications which satisfies all the needs.
6. Discussion with Customers about the product and the specifications.
7. Discussion about the finished product and taking feedback.
8. Feedback Analysis and redesign if required.
9. Verification of redesigned product and market study.
10. Discussion on different Purchasing and Services for the product development.
11. Data from the customer for market and feedback of market is acquired.
12. Activity on Observation skills to know how to use one's observation skills in understanding the parameters
13. Brainstorming deliberations on the initial observations and measuring of the product.
14. Familiarization of the respective templates with the help of sample case study.

4. Books and Materials

Text Books:

1. Mileta M Tomovic, Sowping Wang, Product Realization – A Comprehensive Approach, 1st Edition, Spinger, 2009.
2. Stark, John, Product Life Cycle Management, 21st century Paradigm for Product Realisation 2011, Springer.

Reference Books:

1. Verna J. Bowen, Lucy V. Fusco, The Competitive Edge Research Priorities for U.S. Manufacturing, National Academy of Sciences.
2. Renuka Thota, Suren Dwivedi, Implementation of product realization concepts in design and manufacturing courses, University of Louisiana-Lafayette.

Course Structure

A8032 - Environmental Science and Technology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

This course enables the students to engage with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. This course requires that the students should identify and analyze the natural and human-made environmental problems and evaluate the relative risks associated with these problems. It provides the scope to examine alternative solutions for resolving or preventing them. It is essentially a multidisciplinary approach that brings out an appreciation of our natural world and human impact on its existence and irrigational control measures. Its components include Biology, Geology, Chemistry, Physics, Engineering, Sociology, Health, Anthropology, Economics, Statistics, Computers and Philosophy, engineering technology, Integrating sustainable development into their engineering practice.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8032.1. Illustrate the important components of environment.

A8032.2. Identify global environmental problems to come out with best possible solutions.

A8032.3. Make use of environmental laws & environmental ethics for the protection of forest and wildlife..

A8032.4. Apply to maintain harmonious relation between nature and human being and integrating sustainable development goals into their engineering practice.

A8032.5. Analyse the major environmental effects of exploiting natural resources.

3. Course Syllabus

Fundamentals of Environment and Ecology: The multidisciplinary nature of environmental studies, environmental ethics, Global environmental issues, Planetary boundaries, Fundamentals of ecology - ecosystem definition, structure and functions of ecosystem, food

chain and food web, feedback loops, Ecosystem services.

Natural Resources and Management: Classification of resources: Renewable and Non-renewable re- sources. Forest resources: Uses and over exploitation of forests. Dams and their environmental impacts. Water resources: Use and over utilization of surface and ground water, conflicts over water. Energy resources: Renewable energy resources: solar energy, wind energy and geothermal energy. Food resources: Problems with Chemical fertilizers and pesticides. Biofertilizers (organic farming) and their importance. Bio-geo chemical cycles, Socio-ecological systems

Biodiversity and Its Conservation: Introduction and definition. Genetic diversity, species diversity and ecosystem diversity. Values of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values. Man-wildlife conflicts. In-situ and Ex-situ conservation of biodiversity, Biodiversity Law.

Environmental Pollution and Control: Definition, causes, effects and control measures of Environmental pollution, Air pollution, water pollution, Soil pollution, solid and hazardous waste management, Noise pollution, E-waste, bio-medical waste, Wastewater treatment and emerging pollutants, Standards for Air and Water.

Concept of sustainable development: Sustainable development goals, Carbon footprints, Net-Zero-Emissions, Montreal protocol a success story, Conference of parties (CoP), IPCC, Kyoto protocol, Environmental Acts, Life cycle analysis, Circular Economy, Sustainable Living, Ecological Engineering- ecological restoration, natural and constructed wetlands, nature-based solutions. Case Studies: Mission Kakatiya, Chipko Movement, Water Man of India (Dr. Rajendra Singh), Watershed management.

4. Books and Materials

Text Books:

1. Anubha Kaushik, C.P. Kaushik. Perspectives in Environmental Studies. 6th Edition, New age international publishers, 2018.
2. M. Anji Reddy. Textbook of Environmental Science and Technology, Revised Edition, BS Publications, 2014.

Reference Books:

1. Erach Bharucha. Textbook of Environmental Studies for Undergraduate Courses, 2nd Edition, Orient BlackSwan Publishers, 2013.
2. Benny Joseph, Environmental studies, 3rd Edition, McGraw Hill Education (India) Private Limited, 2018.

III YEAR I SEMESTER

Course Structure

A8118 - Design of Reinforced Concrete Structures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course introduces concepts of reinforced concrete design as per limit state method. Application of basic principles of mechanics in the analysis and design of reinforced concrete elements are also discussed. The course covers design procedures for RC elements – slab, beam, column, footing and staircase as per IS 456: 2000.

Course Pre/co-requisites

A8114 - Concrete Technology

A8115 - Structural Analysis

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8118.1. Apply concepts of reinforced concrete design to the singly reinforced, doubly reinforced and flanged sections.
A8118.2. Illustrate shear, torsion and bond behaviour of beams.
A8118.3. Distinguish one-way and two-way slabs design procedures.
A8118.4. Assess columns for axial loaded, uniaxial and biaxial bending conditions.
A8118.5. Design of footings and staircase as per the provisions of IS 456.

3. Course Syllabus

Concept of RC Design: Different methods of Design – Limit State method – Material Stress - Strain Curves - Safety factors - Characteristic values. Stress Block parameters - IS 456: 2000 Beams: Limit state analysis and design of singly reinforced, doubly reinforced, T-sections.

Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion - concept of bond, anchorage and development length - I.S. code provisions.

Design of Slabs: Introduction to slabs, Design of one-way slab, Design of Two- way slabs. Limit state of serviceability.

Design of Columns: Introduction to Columns, Short column, Long column, End conditions, Use of design charts - Design for Axial loads, uni-axial and bi-axial bending – IS Code provisions.

Design of Footing & Staircase: Introduction to Footings, Design of Isolated (square, rectangular) footings. Introduction to stair cases, types of staircases, Design of dog-legged staircase.

4. Books and Materials

Text Books:

1. N.Krishna Raju and R.N. Pranesh, Reinforced Concrete Design: IS:456-2000 Principles And Practice, 1st Edition, New age International Publishers, New Delhi, 2008
2. P.C.Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India, New Delhi, 2nd Edition, 2005

Reference Books:

1. S.Unnikrishna Pillai & Devadas Menon, Reinforced concrete design, Tata Mc. Graw Hill, New Delhi, 3rd edition, 2017
2. M.L. Gambhir, Fundamentals of Reinforced concrete design, Prentice Hall of India Ltd., New Delhi, 2006
3. IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards, New Delhi
4. SP 16 (1980), Design Aids for Reinforced Concrete to IS 456:1978, Bureau of Indian Standards, New Delhi

Course Structure

A8119 - Water Resources Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides with technical expertise in engineering hydrology to address the complexities of real-life engineering hydrology problems. In this course, students will learn about the hydrological cycle and its components, initial abstractions and hydrograph analysis, occurrence and movement of groundwater and aquifer parameters. In addition, students can also gain knowledge on hydrology of floods, irrigation water requirements and design discharge of water course.

Course Pre/co-requisites

A8107 - Fluid Mechanics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8119.1. Interpret various components of hydrologic cycle for the management of water resources.
A8119.2. Analyze initial abstractions of precipitation, runoff and hydrographs.
A8119.3. Determine flood discharge, flood routing methods and flood control structures.
A8119.4. Estimate aquifer parameters and flow to wells.
A8119.5. Assess crop water requirement, irrigation techniques and design discharge of a water course.

3. Course Syllabus

Components of Hydrologic Cycle: Concept of Hydrologic cycle, Precipitation, Cloud Seeding, measurement of precipitation, types of rain gauges, rain gauge network, optimum number of rain gauges, presentation of rainfall data – hyetograph and mass curve, test for consistency and continuity of rainfall data, maximum intensity/depth-duration-frequency relationship, Mean Precipitation Over an Area by Arithmetic Mean, Thiessen Polygon and Isohyetal Methods, depth area duration relationships, estimation of missing rainfall data, Double Mass Curve, Probable Maximum Precipitation (PMP)

Initial Abstractions, Runoff and Hydrograph Analysis: Evaporation and Evaporation Process, measurement, estimation and control of evaporation, Evapotranspiration, measurement and estimation of evapotranspiration, Infiltration, factors affecting infiltration, measurement of infiltration, infiltration curve and infiltration indices. Runoff: component of runoff, factors affecting runoff, Basin Yield, SCS-CN method of estimating runoff, Rainfall-Runoff relationships, flow duration and flow mass curves. Hydrograph Analysis: Components of Hydrograph, Hydrograph Separation, Unit Hydrograph.

Floods and Flood Routing: Definition, Causes of Floods, Flood Discharge Formulae and Envelope Curves, Flood Frequency Analysis, Flood Control Dams, Detention Basins, Levees, Diversion Channels, Flood Channel Improvement Schemes. Flood Routing: Routing Through a Reservoir by I.S.D. Method, Channel Routing by Muskingum Method, Broad Outline on the National Policy on Floods.

Groundwater Hydrology: Groundwater Occurrence, Types of Aquifers, Aquifer parameters, Porosity, Specific yield, Permeability, Transmissivity and Storage coefficient, Darcy's law, Radial flow to wells in confined and unconfined aquifers, Types of wells.

Irrigation: Necessity and Importance of Irrigation, Advantages and ill effects of Irrigation, Types of Irrigation, Methods of application of Irrigation water, Methods of improving soil fertility, Crop Rotation, Soil – water – plant relationship, Vertical distribution of soil moisture, Consumptive use, Duty and delta, factors affecting duty, Design discharge for a water course, Depth and frequency of Irrigation, Irrigation efficiencies, Water Logging.

4. Books and Materials

Text Books:

1. Jayarami Reddy, Engineering Hydrology, 3rd Edition, Laxmi Publications Pvt. Ltd., Reprint 2016.
2. B. C. Punmia, P. B. Lal, A. K. Jain, A. K. Jain, Irrigation and Water power engineering, 16th Edition, Laxmi Publications Pvt. Ltd., 2019.
3. P. N. Modi, Irrigation Water Resources and Water Power Engineering, 9th Edition, Standard Book House, 2014.

Reference Books:

1. S. K. Garg, Irrigation and Hydraulic structures, 5th Edition, Khanna Publishers, 2012.
2. K. Subramanya, Engineering Hydrology, 4th Edition, Tata Mc Graw Hill Publishing Company Ltd., 2017.

Course Structure

A8120 - Geotechnical Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the basic concepts of soil mechanics. The basic soil-water interactions and the stress distribution within the soil masses are brought into picture. The classical theories of soil mechanics are used to explain index and engineering properties of the soil such as relative density, grain size distribution, Atterberg limits, permeability, shear strength and compressibility characteristics. The index and engineering properties of soils are used in analysis and design of structures like earth retaining walls and foundations.

Course Pre/co-requisites

A8106 - Strength of Materials – I

A8108 - Fluid Mechanics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8120.1. Classify the soils based on index properties.
A8120.2. Apply the principles of soil mechanics in order to find the permeability and compaction characteristics.
A8120.3. Analyze the stress distribution of soil under various loading conditions.
A8120.4. Estimate magnitude and rate of settlement of soil.
A8120.5. Evaluate the shear strength of soil.

3. Course Syllabus

INTRODUCTION: Origin- Soil formation – Three phase diagram, Mass- volume relationships, Relative density, soil structure and clay minerology. INDEX PROPERTIES OF SOILS: Grain size analysis – Sieve and Hydrometer methods – Consistency limits and indices – I.S. Classification of soils.

PERMEABILITY: Darcy's law – Permeability – Factors affecting permeability – Laboratory determination of coefficient of permeability – Permeability of layered systems. SEEPAGE THROUGH SOILS: Total, neutral and effective stresses – Capillarity – Seepage – Flow

net: Properties and its Applications, Quick sand condition.

STRESS DISTRIBUTION IN SOILS: Boussinesq's and Westergaard's theories - Vertical stress for point loads and areas of different shapes – Newmark's influence chart – Approximate method. COMPACTION: Mechanism of compaction – factors affecting compaction – effect of compaction on soil properties – field compaction equipment – compaction quality control.

CONSOLIDATION: Spring Analogy - Void ratio and effective stress (e v/s log p) relationship – Stress History - Terzaghi's theory of one-dimensional consolidation – Computation of magnitude of settlement and time rate of settlement.

SHEAR STRENGTH OF SOILS: Importance of shear strength – Mohr Coulomb's Failure theories – Shear Parameters – Mohr's circle, Laboratory tests for determination of shear strength – Direct shear test, Tri-axial compression test (UU, CU and CD) – Unconfined compression tests - Vane shear test.

4. Books and Materials

Text Books:

1. Narasinga Rao B.N.D., Soil Mechanics and Foundation Engineering, Wiley Publishers, 2019
2. Venkataramaiah C., Geotechnical Engineering, New Age International Pvt. Ltd. Publishers, 6th Edition, 2018

Reference Books:

1. Arora, K.R., Soil Mechanics and Foundation Engineering, 7th reprint edition, Standard Publishers and Distributors, Delhi, 2019
2. Gopal Ranjan and Rao, A.S.R., Basic and Applied Soil Mechanics, New Age International Pvt. Ltd. Publishers, 2019
3. Braja, M. Das, Principles of Geotechnical Engineering, 8th Edition, Cengage Learning Pvt. Ltd., 2015

Course Structure

A8121 - Transportation Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Transportation engineering is one of the branch of civil engineering, which deals with the planning, design, construction, and maintenance of highways at local and regional levels. Highway engineers work to ensure the safe, economical and timely movement of people and goods. This course basically deals with highway planning, geometric design, traffic management, pavement materials testing, and pavement design.

Course Pre/co-requisites

A8107 - Surveying

A8114 - Concrete Technology

A8120 - Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8121.1. Apply the principles involved in planning and design of various transportation facilities.

A8121.2. Analyze various forces acting on the vehicles in the geometric design of a highway.

A8121.3. Develop various traffic regulatory and control measures.

A8121.4. Discuss highway alignment and materials characterization.

A8121.5. Design flexible and rigid pavements for a given traffic and climatic conditions.

3. Course Syllabus

HIGHWAY DEVELOPMENT AND ALIGNMENT: Highway Development in India – Highway Planning, Different Road Development Plans, Classification of Roads; Highway Alignment – Factors affecting Alignment, Engineering Surveys, Drawings and Reports.

HIGHWAY GEOMETIC DESIGN: Importance of Geometric Design, Highway Cross Section Elements, and Sight Distance Elements – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance; Design of Horizontal Alignment – Super elevation, Extra widening, Transition Curves; Design of Vertical Alignment – Gradients and Vertical

Curves.

TRAFFIC ENGINEERING: Basic Parameters of Traffic – Volume, Speed, Density and their relation, Volume Studies – Speed Studies – Traffic Signs – Road Markings –Traffic Signals – Webster Method; Rotary Intersection – Design factors and capacity; Grade Separated Intersections.

PAVEMENT MATERIALS: Material characterization - Tests on soils: CBR, modulus of sub-grade reaction, Tests on Aggregates: specific gravity, shape (flakiness and elongation indices), angularity number, water absorption, impact, abrasion, attrition crushing resistance, durability (weathering resistance). Tests on bitumen: penetration, softening point, viscosity, ductility, flash and fire points. Introduction to modified bituminous binders like crumb rubber modified, natural rubber modified and polymer modified bitumen binders, Mix design.

PAVEMENT DESIGN: Factors affecting design of pavements, ESWL Concept, Vehicle Damage Factor, Westergaard's stress equations. Types of pavements and their typical cross sections: flexible, rigid and composite; Flexible Pavement analysis and design: IRC 37- 2018 method. Rigid pavement analysis and design: Factors controlling rigid pavement design, types of stresses in rigid pavements and joints of concrete pavements, IRC 58-2015 method for design.

4. Books and Materials

Text Books:

1. S. K. Khanna, C. E. G. Justo, and A. Veeraragavan, Highway Engineering, Nemchand & Bros., New Delhi, Revised 10th Edition, 2014.
2. L. R. Kadiyali, Traffic Engineering & Transportation Planning, Khanna Publications, New Delhi, 6th Edition, 1997.

Reference Books:

1. L. R. Kadiyali, Principles and Practices of Highway Engineering, Khanna Book Publishing Co. (P) Ltd., New Delhi, 7th Edition, 2018.
2. IRC 37-2018: Guidelines for the Design of Flexible Pavements (Fourth Revision), Indian Roads Congress, New Delhi.
3. IRC 58-2015: Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision), Indian Roads Congress, New Delhi.

Course Structure

A8122 - Geotechnical Engineering Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course imparts a firsthand experience in analysing and determining the index and the engineering properties of the soil. The index properties assist as a preliminary indicator of the engineering property of the soil. The index properties are determined for the classification of the soils. While the engineering properties are used in the design and analysis for various works like earth retaining walls and foundation design. The basic parameters needed for the selection of type of foundations are determined by simple laboratory experiments. The in-situ tests conducted will help in understanding the field condition at site and helps to take the necessary engineering measures.

Course Pre/co-requisites

A8120 – Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8122.1. Determine the index properties of the soil.
A8122.2. Classify the soil based on the index properties of the soil.
A8122.3. Evaluate the field quality control of embankments ad subgrades.
A8122.4. Determine the engineering properties of the soil.
A8122.5. Estimate the shear strength under controlled drainage conditions.

3. List of Experiments

1. Determination of Specific Gravity of soil
2. Determination of Grain size analysis
3. Determination of Atterberg Limits: a) Liquid limit; b) Plastic limit; c) Shrinkage limit
4. Determination of Field density by: a) core cutter method; b) Sand replacement method
5. Determination of Permeability of soil by: a) Constant head test; b) Variable head test
6. Determination of Optimum moisture content and Maximum dry density by Proctor compaction test
7. Determination of settlement parameters by consolidation test

8. Determination of Shear strength parameters by using: a) Triaxial test apparatus; b) Direct shear test apparatus; c) Unconfined compression test apparatus

4. Laboratory Equipment/Software/Tools Required

1. Electronic Weigh Balance
2. Pycnometer
3. Set of IS sieves
4. Casagrande's apparatus
5. Plastic limit and Shrinkage limit apparatus
6. Sand replacement apparatus
7. Core cutter apparatus
8. Permeability test apparatus
9. IS Light compaction apparatus
10. Consolidation apparatus
11. Direct shear test apparatus
12. Unconfined compression test apparatus
13. Triaxial test apparatus
14. Hot air oven

Course Structure

A8123 - Transportation Engineering Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course deals with the characterization of the pavement materials such as aggregate, soil, and bitumen. Further, the course provides an understanding about the traffic flow speed patterns for futuristic planning and design.

Course Pre/co-requisites

A8121 – Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8123.1. Characterize the aggregate and soil for pavement applications.
A8123.2. Examine the tests performed for bitumen.
A8123.3. Design bituminous mix using Marshall Method.
A8123.4. Analyze the spot speed and their patterns.
A8123.5. Prepare a laboratory report.

3. List of Experiments

1. Aggregate crushing and impact tests
2. Specific gravity and water absorption
3. Abrasion and Attrition tests
4. Shape Tests – Flakiness index and Elongation index
5. Penetration test
6. Ductility test
7. Softening point test
8. Flash and fire point tests
9. California Bearing Ratio test
10. Bitumen Mix Design
11. Traffic speed study

4. Laboratory Equipment/Software/Tools Required

1. Set of IS Sieves
2. Compression Testing Machine with crushing test attachment
3. Pycnometer
4. Aggregate Impact Testing Setup
5. Deval's Attrition Testing Machine
6. Los Angeles Abrasion Testing Machine
7. Thickness and Length Gauges
8. Bitumen Penetrometer
9. Ductility Testing Machine
10. Softening Point Test Setup
11. Flash and Fire Point Test Setup
12. Marshal Stability Test Setup
13. California Bearing Ratio Test Setup
14. Radar Speed Gun

Course Structure

A8124 - Civil Engineering Software Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This laboratory course deals with application of theoretical concepts in analysing practical problems using civil engineering software. The structural engineering experiments introduces a finite element analysis simulation tool to the students. The concepts involved in converting a real structural problem into structural simulation model are discussed. The experiments on pavement system will include the mechanistic analysis of the pavement as per the design needs using IITPAVE and KENSLAB/IITRIGID. The experiments in geotechnical engineering includes the data interpretation of laboratory test results for index properties of soil using spreadsheet technique. The water resources experiments are designed to provide the students with technical expertise in design of water distribution system using EPANET to address the complexities of real-life water distribution problems. The basics in planning, designing and modelling of water demand and distribution using of EPANET.

Course Pre/co-requisites

A8115 - Structural Analysis
A8119 - Water Resources Engineering
A8120 - Geotechnical Engineering
A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8124.1. Apply theoretical concepts to analyse practical problems using civil engineering software.
A8124.2. Analyse structural members using finite element analysis software ANSYS.
A8124.3. Interpret the test result data of index and engineering properties of soil obtained in laboratory.
A8124.4. Analyze flexible pavement system with cement-treated and recycled materials.
A8124.5. Design of Water Distribution Networks using EPANET.

3. List of Experiments

Structural Engineering:

1. Linear static analysis of bar
2. Linear static analysis of beam
3. Linear static analysis of truss
4. Linear static analysis of portal frame

Geotechnical Engineering:

5. Interpretation of data obtained from Sieve analysis and hydrometer analysis
6. Interpretation of data obtained from Atterberg limits' test.
7. Interpretation of data obtained from Shear strength tests.

Transportation Engineering:

8. Analysis of stresses and strains in a multi-layer flexible pavement system
9. Analysis of stresses and strain in a flexible pavement system with inverted base layers/Stress Absorbing Membrane/Aggregate interlayer.
10. Sublayer analysis for flexible pavement system with inverted base layers/Stress Absorbing Membrane/Aggregate interlayer.
11. Analysis of stresses in rigid pavements.

Water Resources Engineering:

12. Project Setup and Drawing the Water Distribution Network
13. Setting the EPANET Object parameters Properties
14. Running a Single Period and Extended Period Hydraulic Analysis
15. Analyzing and Exporting the Results

(Minimum 10 experiments to be performed; at least 2 from each domain)

4. Laboratory Equipment/Software/Tools Required

1. Desktop PCs
2. ANSYS
3. MS Office
4. IITPAVE
5. KENSLAB/IITRIGID
6. EPANET

Course Structure

A8034 - Indian Constitution

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

This course enables the students to understand the constitution of India as the Supreme law of India. The student will also gain knowledge about the parliament of India and how it functions. This course will survey the basic structure and operative dimensions of the Indian constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian constitution.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8034.1. Identify the important components of Indian Constitution.
A8034.2. Apply the fundamental rights in right way and become a more responsible citizen.
A8034.3. Illustrate the evolution of Indian Constitution.
A8034.4. Identify the basic structure of Indian Constitution.
A8034.5. Relate the basic concepts of democracy, liberty, equality, secular and justice.

3. Course Syllabus

Evolution of Indian constitution: Indian independence act 1947, formation of constituent assembly of India, committees of the constituent assembly, constitution of India drafting committee, brief study about Indian Constitution drafting committee Chairman, time line of formation of the constitution of India.

Structure of the constitution of India: Parts, schedules, appendices, constitution and government, constitution and judiciary.

Preamble to the constitution of India: Brief study about sovereignty, socialist, secularism, democracy, republic, justice (political justice, social justice, economic justice), liberty, equality, fraternity, unity & integrity.

Acts: Salient Features, Provisions of the acts: Right to education act, right to information act, anti-defection law, Jan Lokpal bill.

Fundamental rights: Right to equality, right to freedom (freedom of speech and expression, right to practice any profession etc.), right against exploitation, right to freedom of religion, cultural & education rights, right to property, right to constitutional remedies

4. Books and Materials

Text Books:

1. Dr. Durga das basu.Introduction to the constitution of India, 21st Edition, Lexis Nexis books publication Ltd, 2013.

Reference Books:

1. Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.
2. Arun K Thiruvengadam, The Constitution of India, 1st Edition, Hart publishing India, 2017.

III YEAR II SEMESTER

Course Structure

A8125 - Design of Steel Structures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides fundamental concepts, principles and components of steel structures. It introduces the design of steel structures using the limit state design philosophy. This course also introduces statutory requirements, design standards and also deals with design of connections, tension members, compression members, plate girders and roof trusses as per IS 800 codal provisions.

Course Pre/co-requisites

A8106 - Strength of Materials-I

A8112 - Strength of Materials-II

A8115 - Structural Analysis

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8125.1 Determine strength parameters of bolted and welded connections.
A8125.2 Analyze tension members, compression members, and flexure members.
A8125.3 Assess various components of roof trusses for different loads.
A8125.4 Evaluate columns and column bases for different loading conditions.
A8125.5 Design plate girders using different stiffener connections.

3. Course Syllabus

MATERIALS AND SPECIFICATIONS: Steel, Structural steel, rolled steel sections, Design criteria for limit state method, Plastic moment of sections, classification of cross sections.

BOLTED CONNECTIONS: Introduction Bolted Connections -Types of bolts - Types of failure, Design specifications, High strength bolts, Efficiency of joint - Prying action.

WELDED CONNECTIONS: Specifications for welding – Design of fillet welds, groove welds, Design Strength - Efficiency of joint.

TENSION MEMBERS: Introduction. Types of tension member, types of failures, Design of Tension members - Design Strength of members.
COMPRESSION MEMBERS: Introduction, Types of sections Design of compression members, Buckling class, slenderness ratio, design strength, design of single angle and double angle sections.

BEAMS: Introduction, Bending and shear strength. Design strength in bending, Design strength in shear. Design of laterally supported and un supported beams, Web Buckling, Crippling and Deflection of Beams.
ROOF TRUSSES: Introduction, Types of trusses - Types of loads - Design of purlins.

DESIGN OF COLUMNS: Design of rolled steel column, Design of Laced columns, Design of battened columns.
COLUMN BASES: Types, Design of slab base and gusseted base.

WELDED PLATE GIRDER: Components of plate girders, optimum depth. Design of main section. Design of end bearing stiffeners and intermediate stiffeners.

4. Books and Materials

Text Books:

1. S. K. Duggal, Limit state Design of Steel Structures, McGraw-Hill; 3rd edition, New Delhi, 2019
2. S. S. Bhavikatti, Design of Steel Structures, I K International Publishing House Pvt. Ltd. 5th edition, 2017

Reference Books:

1. N. Krishnaraju, Structural Design and Drawing, Universities Press (India) Private Limited, 2021
2. N. Subramanian, Steel Structures Design and Practice, Oxford; Edition, 2010

Course Structure

A8126 - Advanced Structural Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is offered to undergraduate students to deal with matrix methods to solve indeterminate structures. The course introduces Muller Breslau principle to solve continuous beams. This course also discusses analysis of indeterminate structures using Kani's method. Graphical representation of bending moment and shear force in continuous beams using influence line diagrams is also included.

Course Pre/co-requisites

A8115 – Structural Analysis

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8126.1. Apply various theorems to solve indeterminate trusses.
A8126.2. Solve continuous beams using Muller Breslau principle.
A8126.3. Develop shear force, bending moment and influence line diagrams for indeterminate structures.
A8126.4. Analyze continuous beams using matrix methods approach.
A8126.5. Evaluate rotations for indeterminate structures.

3. Course Syllabus

KANI'S METHOD: Analysis of continuous beams including settlement of supports - Analysis of single bay single storey and single bay two storey Frames including Side sway - Shear force and bending moment diagrams.

INFLUENCE LINES: Definition of influence line for SF, Influence line for BM- load position for maximum SF at a section- Load position for maximum BM at a section - point loads, UDL longer than the span, UDL shorter than the span. Influence lines for continuous beams with constant and variable moment of inertia.

STIFFNESS MATRIX METHOD: Introduction – force displacement relations- element stiffness matrix for beams– Analysis of continuous beams with and without settlement of

supports.

FLEXIBILITY MATRIX METHOD: Introduction – force displacement relations- element flexibility matrix – relation between stiffness matrix and flexibility matrix- analysis of continuous beams with and without settlement of supports.

INDETERMINATE TRUSSES: Types and classification of trusses- Castigliano's theorem, Betti's theorem, force method for analysis of trusses having single and two degree of internal and external indeterminacies.

4. Books and Materials

Text Books:

1. G.S. Pundit and S.P. Gupta, Structural Analysis - A Matrix approach, 2nd edition, Tata McGraw Hill Publishers, 2008.
2. S. S. Bhavikatti, Structural Analysis Vol I & Vol II, 4th edition, Vikas publishing house Pvt. Ltd, 2010.

Reference Books:

1. C.S. Reddy, Basic Structural Analysis, 3rd edition, Tata McGraw Hill Publishers, 2017.
2. S.S. Bhavikatti, Matrix methods of structural analysis, 1st edition, I K international publishing house Pvt Ltd, 2011.
3. R.K. Livesley, Matrix methods of structural analysis, 2nd edition, The commonwealth and international library of science Technology Engineering and Liberal studies, 2014.

Course Structure

A8127 - Environmental Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is designed to provide the engineering graduates with technical expertise in Environmental Engineering which will enable them to have a career and professional accomplishment in the public or private sector to address the complexities of real-life environmental engineering problems related to, water sources, population forecasting, water demand, water quality, water treatment, water supply, sewerage system, sewage treatment, Effluent, Sludge Treatment and Disposal.

Course Pre/co-requisites

A8008 - Engineering Chemistry

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8127.1. Analyze water supply scheme, Population forecasts, water demands and water quality parameters.
A8127.2. Design water treatment units along with water distribution systems.
A8127.3. Examine sewerage and house drainage system components.
A8127.4. Assess primary and biological wastewater treatment processes and design its units.
A8127.5. Propose treatment and disposal methods of sewage, sludge.

3. Course Syllabus

Basic Concepts of Water Supply: Water supply Schemes, Protected water supply, Population forecasts, design period, water demand - types, factors affecting, fluctuations, fire demand. Sources of Water, intakes, infiltration galleries, water quality parameters and testing, drinking water quality standards, Water quality index.

Water Treatment and Distribution: Layout and general outline of water treatment units. Sedimentation - principles, design factors, coagulation-flocculation, Jar test - optimum dosage of coagulant, clarifier design, coagulants, feeding arrangements. Filtration - theory, working of slow and rapid gravity filters, multimedia filters, design of filters, filter

troubles in operation, comparison of filters. Disinfection - methods of disinfection, theory of chlorination, chlorine demand. Water Distribution - types and layouts of distribution systems, design of distribution systems, Service Reservoirs, Determination of reservoir storage capacity.

Sewerage Systems: Conservancy and Water carriage systems, Sewage and Storm water estimation, Time of concentration, Characteristics of sewage, examination of sewage, B.O.D, C.O.D equations. Shapes and materials of sewer, Sewer appurtenances - manholes, inverted siphon, catch basins, flushing tanks ejectors, pumps and pumping houses, house drainage components, requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing.

Wastewater Treatment: Layout and general outline of various units in a wastewater treatment plant, primary treatment, design of screens, grit chambers, skimming tanks, sedimentation tanks, principle and design of biological treatment, Trickling Filters, standard and high rate - Filters, Activated Sludge Process (ASP), Aeration, Modifications of ASP. Upflow Anaerobic Sludge Blanket Systems (UASB), Construction and design of oxidation ponds, Oxidation ditches.

Effluent, Sludge Treatment and Disposal: Common Effluent Treatment Plants (CETPs) and their drawbacks, Decentralized effluent treatment plants. Unit processes and operations. Effluent discharge standards for disposal, zero liquid discharge (ZLD) strategy. Sludge treatment and disposal, Septic tanks working principles and design, soak pits, low-cost wastewater treatment systems, Ultimate disposal of wastewater, self-purification of rivers, Sewage farming.

4. Books and Materials

Text Books:

1. G.S.Birdie , J. S.Birdie, Water supply & Sanitary Engineering ,9th Edition ,Dhanpat Rai Publishing Co Pvt Ltd, 2014.
2. B.C.Punmia, Ashok Jain, Arun Jain, Water supply Engineering – Environmental Engineering (Volume-I), 2nd Revised edition, Laxmi Publications (P) Ltd, 2016.

Reference Books:

1. H.S Peavy, D. R. Rowe, G. Tchobanoglous, Environmental Engineering, Indian Edition, McGraw Hill Education (India) Pvt Ltd, 2014.
2. D. P. Sincero and G.A Sincero, Environmental Engineering, Pearson Education India, 2015.

Course Structure

A8128 - Environmental Engineering Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course is designed to provide the engineering graduates with technical expertise in Environmental Engineering Laboratory. Environmental engineering lab is concerned with the application of basic chemistry and chemical calculations to measure physical, chemical, and bacteriological parameters of water and wastewater. Laboratory methods and interpretation of results with regard to environmental engineering applications will enable students to have a career and professional accomplishment in the public or private sector to address the complexities of real-life environmental engineering problems related to, water and wastewater quality.

Course Pre/co-requisites

A8009 - Engineering Chemistry Laboratory

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8128.1. Determine physical, chemical and biological characteristics of water and wastewater.
A8128.2. Analyze the quality of water and wastewater.
A8128.3. Estimate optimum dosage of coagulant.
A8128.4. Interpret water quality according to water quality standards.
A8128.5. Prepare the water quality reports for the required purpose.

3. List of Experiments

1. Determination of pH
2. Determination of Turbidity
3. Determination of Conductivity
4. Determination of Alkalinity
5. Determination of Total solids (TDS & TSS)
6. Determination of Dissolved Oxygen
7. Determination of Chlorides

8. Determination of Iron
9. Determination of Nitrates
10. Determination of phosphates
11. Determination of Fluorides
12. Determination of Optimum dose of coagulant
13. Determination of Hardness
14. Determination of B.O.D.
15. Determination of C.O.D.

4. Laboratory Equipment/Software/Tools Required

1. Digital pH Meter
2. Digital Turbidity Meter
3. Digital Conductivity Meter
4. Digital TDS Meter
5. Digital DO Meter
6. Muffle Furnace
7. COD Heater Block
8. BOD Incubator
9. Jar Test Apparatus
10. Hot Air Oven
11. Refrigerator
12. Micro Balance
13. Spectrophotometer

Course Structure

A8129 - Structural Analysis and Design Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This lab introduces structural analysis and design simulation tools to the students. Spreadsheets for design of different structural components of RC structure are developed as per IS codes. Various structural engineering models such as beams with different support conditions, trusses and frames are analysed for different loading conditions to evaluate reaction forces and displacements. Analysis and design of a multi-storey RC frame building and steel structure subjected to gravity loads is also discussed.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8129.1. Develop spreadsheet-based designs as per IS codes.
A8129.2. Model various structural components using simulation tool.
A8129.3. Analyse beams, trusses, and frames for different loads.
A8129.4. Design multi-storey RC frame building for gravity loads as per IS codes.
A8129.5. Evaluate steel structure for gravity loads as per IS codes.

3. List of Experiments

1. Develop design spreadsheet for rectangular beams
2. Develop design spreadsheet for column
3. Develop design spreadsheet for one-way slab
4. Develop design spreadsheet for isolated footing
5. Analysis of beams for different types of loads
   i. simply supported beam
   ii. cantilever beam
   iii. fixed beam
   iv. Continuous beam

6. Analysis of plane and space frames
7. Analysis and design of multi-storey RC building for gravity loads
8. Analysis and design of steel members
9. Analysis of plane and space steel trusses
10. Analysis and design of steel structure for gravity loads

4. Laboratory Equipment/Software/Tools Required

1. Desktop PCs
2. MS Office
3. STAAD Pro software

Course Structure

A8012 - Advanced English Communication Skills Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This Lab focuses on grooming the students professionally and empowering them through language development. This course facilitates them to hone their vocabulary and listening skills enabling them to prepare for competitive examinations. This course also polishes the students' presentation skills in different professional contexts besides developing proficiency in reading and writing. Further, they would be outfitted to communicate their ideas relevantly in group discussions and develop proficiency in preparing for interviews, thus making students ready for industry.

Course Pre/co-requisites

A8010 - English for Skill Enhancement
A8011 - English Language and Communication Skills Laboratory

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8012.1. Improve comprehensive skills in listening and reading.
A8012.2. Develop effective technical writing skills and e- correspondence.
A8012.3. Build communication skills in different socio-cultural and professional contexts.
A8012.4. Organize the dynamics of group discussion for effective participation.
A8012.5. Analyze strategies to succeed in interviews.

3. Course Syllabus

Theory

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills Laboratory **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.

Activities on Writing Skills: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé – Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types

and Formats of Reports– Technical Report Writing– Exercises for Practice.

Activities on Presentation Skills: Starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation – Dealing with Glossophobia or Stage Fear – Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.

Activities on Group Discussion (GD): Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion- Myths of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas – Do's and Don'ts - GD Strategies – Exercises for Practice.

Interview Skills: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

4. Laboratory Equipment/Software/Tools Required

1. Audio Visual Equipment (Public Address System, LCD Projector and Camcorder).
2. One PC with latest configuration for the teacher.
3. Delta's key to the Next Generation TOEFL, Test: Advanced Skill Practice.
4. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
5. Oxford Advanced Learner's Dictionary, 10th Edition.
6. Cambridge Advanced Learner's Dictionary.
7. Lingua TOEFL CBT Insider, by Dreamtech.

5. Books and Materials

Text Books:

1. M. Ashraf Rizvi, Effective Technical Communication, 2nd Edition, McGraw Hill Education, 2018.
2. Suresh Kumar E, Engineering English, 1st Edition, Orient BlackSwan Pvt. Ltd, 2015.
3. Bailey, Stephen, Academic Writing: A Handbook for International Students (5th Edition), Routledge, 2018.
4. Koneru, Aruna, Professional Communication, McGraw Hill Education (India) Pvt. Ltd, 2016.

Reference Books/Additional Resources:

1. Meenakshi Raman & Sangeeta Sharma, Technical Communication, 3rd Edition, Oxford University Press, 2015.
2. Paul V. Anderson, Technical Communication, 8th Edition, Cengage Learning pvt. Ltd., New Delhi. 2013.
3. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart, English Vocabulary in Use Series.

Cambridge University Press, 2017.
4. Sen, Leela, Communication Skills, PHI Learning Pvt Ltd., New Delhi, 2009.
5. Elbow, Peter, Writing with Power. Oxford University Press,1998.
6. Goleman, Daniel, Emotional Intelligence: Why it can matter more than IQ. Bloomsbury Publishing,2013.

Course Structure

A8035 - Research Methodology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

Research is an art of scientific investigation. Research is an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit of truth with the help of study, observation, comparison, and experiment. This course will help students to understand the research process, tools, and importance of ethics. Also, this course helps students to write technical reports.

Course Pre/Co-requisites

This course has no core requisites/pre-requisites

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8035.1. Identify an appropriate research problem in their suitable domain.
A8035.2. Explain the concepts and procedures of sampling, data collection, analysis, and reporting.
A8035.3. Analyze the complex issues inherent in selecting a research problem, research design, and implementing a research project.
A8035.4. Construct a well-structured research paper and scientific presentations.
A8035.5. Express the importance of research ethics in the scientific community.

3. Course Syllabus

Research Methodology: Introduction, meaning, objectives, motivation, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, research process, criteria of good research. **Defining a Research Problem:** Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem.

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs.

Measurement and Scaling: Measurement in research, measurement scales, sources of error in measurement, techniques of developing measurement tools, scale classification bases, scaling techniques.

Data Collection: Collection of primary data, observation method, interview method, collection of secondary data, selection of appropriate method for data collection, case study

method.

Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports. **Research Tools and Techniques:** Methods to search required information effectively, reference management software like Zotero, Mendeley and EndNote, LaTeX (writing paper, thesis, report, bibliography), BEAMER for presentation, software for detection of plagiarism. ethical issues related to publishing, plagiarism and self-plagiarism.

4. Books and Materials

Text Books:

1. C.R. Kothari, Gaurav Garg "Research Methodology: Methods and Techniques" 4th Edition, New Age International, 2018
2. Ranjit Kumar "Research Methodology a step-by step guide for beginners", 3rd Edition, SAGE Publications Ltd, 2011.

Reference Books:

1. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing, 2005
2. Fink A "Conducting Research Literature Reviews: From the Internet to Paper" Stage Publications, 2009

IV YEAR I SEMESTER

Course Structure

A8130 - Remote Sensing and GIS

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course will introduce the students to the modern concepts and practices of remote sensing, photogrammetry and GIS and subsequently advanced methods will be covered. This course is designed to give comprehensive understanding on the application of Remote Sensing and GIS in solving the research and civil engineering problems. Upon completion, the students should be able to use remote sensing (Satellite images and Field data) and GIS in their research work. The course is also going to enhance job opportunity for the civil students and also open an avenue of effective and viable interaction with national establishments related to various aspects of remote sensing and GIS.

Course Pre/co-requisites

A8107 - Surveying

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8130.1. Identify basic concepts, components and processes of Remote Sensing for suitable geospatial applications.
A8130.2. Apply Principles, components of Photogrammetry in different physical measurements.
A8130.3. Select different types of GIS data collection, data input and data representation methods for the required purpose.
A8130.4. Analyze spatial and attribute data using GIS and prepare geospatial maps.
A8130.5. Solve Civil Engineering related problems by using Remote Sensing and GIS techniques.

3. Course Syllabus

Remote Sensing: Basic concepts and foundation of Remote Sensing, Elements involved in Remote Sensing, Electromagnetic spectrum, Energy Interactions with Earth Surface Features and Atmosphere, Resolution, Sensors and Satellites, Visual Image Interpretation Techniques - Basic Elements, Interpretation for Terrain Evaluation, Spectral Properties of Water Bodies, Digital Image Analysis, Image classification techniques and accuracy assessment.

Photogrammetry: Principle and Types of Aerial Photographs, Stereoscopy, Map vs. Mosaic, Ground Control, Parallax Measurements for Height Determinations, Photogrammetric Products, Drone Survey: Aerial mapping and modelling using drone; types of mapping, types of mapping product, Application of drone for Surveying and Mapping.

Geographic Information System (GIS): Definition and Terminology, GIS Categories, Components of GIS, Fundamental Operations of GIS, A Theoretical Framework for GIS. GIS Data Collection, Data Input methods - Keyboard Entry and Coordinate Geometry Procedure, Digitizing and Scanning. Error Detection and Editing, Spatial and Non-Spatial Data, Raster Data Structures, Vector Data Structures.
Web GIS: Definition, concept of Web GIS, History of web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Applications of web GIS, users and stake holders of web GIS, advantages and limitations of web GIS

GIS Spatial Analysis: Computational Analysis Methods (CAM): Spatial measurements, Query and Selection, Reclass /Reclassification, Proximity Analysis and neighbourhood operations/analysis, Buffer and Filter, Overlay, Network Analysis, Visual Analysis Methods (VAM): Surface Analysis, Data storage in GIS, Overview of the Data Manipulation and Analysis. Integrated Analysis of the Spatial and Attribute Data.

Remote Sensing and GIS Applications: Land Use/Land Cover Mapping, Rainfall-Runoff Modelling, Surface Water Mapping, Targeting Groundwater Potential Zones, Identification of Sites for Artificial Recharge Structures, Estimation of Sediment Load, Flood Plain Zoning, Flood, Drought Assessment and Monitoring, Land Suitability Analysis, Landslide Risk Analysis, Road Network Analysis, Identification of Accident Black Spot Locations.

4. Books and Materials

Text Books:

1. M. Anji Reddy, Textbook of Remote Sensing and Geographical Information systems, BS Publications, 2019.
2. James B. Campbell, Randolph H. Wynne, Introduction to Remote Sensing, 5thedition, Guilford Publications Inc, 2011.

Reference Books:

1. Basudeb Bhatta ,Remote Sensing and GIS, 2nd edition, Oxford Higher Education, 2011
2. Peter A. Burragh, Rachael, Principals of Geo physical Information Systems, Oxford Press, 2016.

Course Structure

A8131 - Estimation and Costing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This Course deals with estimation and costing of various types of structures and to determine quantities for approximate and detailed estimates. This course also involves calculation of earthwork quantities for roads and canals, preparation of bar bending schedules, valuation of building and rate analysis of various items of work.

Course Pre/co-requisites

A8105 - Building Construction and Planning

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8131.1. Identify various items of work and materials in construction activities.
A8131.2. Examine the purpose and methods of valuation.
A8131.3. Apply principles of bar bending schedules to calculate steel quantity.
A8131.4. Estimate the quantities of earthwork for roads, canals and perform rate analysis.
A8131.5. Develop detailed and abstract estimates of buildings.

3. Course Syllabus

Introduction: Need for Estimation, Duties of Quantity Surveyor, general items of work in building, Standard UNITs, Specifications and Methods of taking out quantities.

Types of Estimates: Detailed and Abstract estimates of buildings, Methods of Approximate estimate and bar bending schedule.

Earthwork for roads and canals: Lead and Lift, Methods for calculating quantities of earthwork.

Analysis of rates: Prerequisites, factors affecting rate analysis, over head expenses, procedure for rate analysis. Task work: labour requirement for different works, material require-

ment for different works, Rate analysis of different Items of work.

Valuation of Buildings: Purpose of valuation, types of property- Depreciation, Sinking fund, Lease hold and free hold property, obsolescence, Gross income, Outgoing and Net income, Capitalized value and year's purchase. Rental method of valuations, and typical problems.

4. Books and Materials

Text Books:

1. B. N. Dutta (2000), Estimating and Costing, UBS Publishers, New Delhi, India.
2. G. S. Birdie (1982), Estimating and Costing, Dhanpat Rai publications, New Delhi, India

Reference Books:

1. Standard Schedule of rates and standard data book by Public Works Department.
2. I.S. 1200 (Parts I to XXV - 1974/method of measurement of building and Civil Engineering works - B.I.S).
3. Estimating, costing and specifications by M. Chakraborthi; Laxmi publications.
4. National Building Code.

Course Structure

A8132 - Geographical Information Systems Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Geographic Information Systems (GIS) are a set of powerful computerized tools designed to store, retrieve, analyze and display geographically referenced information. GIS are used to explore complex geographic relationships and discover patterns that were previously undetectable through conventional methods. GIS analysis has become important in many industries and provides students with employable skills in several fields of study. In this course students will gain practical knowledge of computer-aided map making, georeferencing, digitization, creation of base maps, thematic maps. Students are able to perform data conversion, spatial analysis, spatial querying and simple applications of GIS in water resources engineering and transportation engineering. In addition, students will also learn effective geospatial data presentation using maps, figures, and tables in the form of power point presentation and posters.

Course Pre/co-requisites

A8117 - Advanced Surveying Laboratory

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8132.1. Choose different types of data inputs and data correction methods in GIS.
A8132.2. Design various spatial layers to produce thematic maps and base maps.
A8132.3. Select suitable data conversion methods.
A8132.4. Analyze spatial and attribute data using GIS software.
A8132.5. Apply GIS in Water Resources Engineering & Transportation Engineering related problems.

3. List of Experiments

1. Familiarization with GIS Software, Data Input
2. Geo Referencing and Projections
3. Digitization of Map/Toposheet
4. Creation of Thematic Maps and Map Composition

5. Base Map Preparation
6. Data Conversion – Vector to Raster, Raster to Vector
7. Adding Attribute Data and Querying on Attribute Data
8. Vector Analysis
9. Raster Analysis
10. Image Classification
11. Developing Digital Elevation Model
12. Simple Applications of GIS in Water Resources Engineering and Transportation Engineering

4. Laboratory Equipment/Software/Tools Required

1. Desktop PCs
2. ArcGIS / QGIS - Anyone or Equivalent
3. SOI Toposheets

Course Structure

A8133 - Building Information Modeling Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course introduces students to the concepts of Building Information Modeling. It emphasizes on the importance of BIM in improving construction practices such as modeling, design/construction co-ordination, scheduling, planning, as-built modeling, and checking. The objective of the course is for the students to learn hands-on skills of using BIM-related software program and real-world project management.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8133.1. Apply the fundamental concepts of Building Information Modeling (BIM).
A8133.2. Model a structure with BIM tool.
A8133.3. Analyze project scheduling and planning using BIM.
A8133.4. Perform project management using BIM.
A8133.5. Evaluate energy performance and model checking of building.

3. List of Experiments

1. Introduction to BIM Concepts
2. Architectural BIM Modelling
3. Basic BIM Concepts in Structural Aspects
4. 3D Spatial Interference Analysis
5. Importance of Project Management
6. Time, Cost and Scope Analysis
7. Scheduling and Planning of Project
8. Energy Modelling
9. 4D Simulation
10. Rule-based model checking

4. Laboratory Equipment/Software/Tools Required

1. Desktop PCs
2. Autodesk Revit

Professional Electives

Course Structure

A8151 - Construction Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The Construction Management course focuses on study of management and technological aspects of residential, industrial, commercial and institutional construction projects as well as engineering and infrastructure construction. The Construction Management course provides practical problems for the students to acquire a unique combination of construction and project management skills in conjunction with the added dimension of protecting the environment and sustainability.

Course Pre/co-requisites

A8105 - Building Construction and Planning

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8151.1 Select appropriate tools and techniques required for construction management.
A8151.2 Identify key issues of building contracts procedures, contract documentation, specifications, and regulations.
A8151.3 Apply techniques of construction planning and management in the execution of projects.
A8151.4 Analyse quality and safety issues involved in construction projects.
A8151.5 Evaluate Resources, Budget, Claims, and Disputes.

3. Course Syllabus

Construction Management: Significance, Objectives and Functions of Construction Management, Types of Construction, Resources for Construction Industry, Various stages in Construction, Construction Management Team, Types of Organization advantages and disadvantages.

Planning and Scheduling Techniques: Work breakdown structure, Bar Charts, limitation of Bar Charts; CPM & PERT: Time estimates, Expected time. Project Scheduling,

Resource Allocation/Levelling, Network Analysis, Float - Total float, Free float.

Contract Management: Elements of Contracts – Types of Contracts – Features – merits and demerits, Contract Document and conditions of contract. Design and Construct Contract, Build Operate and Transfer Contracts, Turnkey Contracts. Estimation and its types.

Tenders and Specifications: Prequalification – Bidding, Tendering and Methods of tendering for projects, tender documents. Importance of specifications. M Book, Muster Roll, Deposits by the contractor - Earnest money and Security Deposit. Quality and Safety Concerns in Construction.

Claim Management: Construction claims and Disputes- Source of claim, Claim Management, Dispute resolution methods, Arbitration and its advantages, Construction closure, contract closure, Project closure.

4. Books and Materials

Text Books:

1. Gahlot P.S., Dhir B.M., Construction Planning and Management, Wiley Eastern Limited, 2014
2. Chitkara, K.K., Construction Project Management, Planning, Scheduling and Controlling, Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2014

Reference Books:

1. Jha, K.N., Construction Project Management, Pearson Education India, 2^{nd} Edition, 2015

Course Structure

A8152 - Subsurface Exploration

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course deals with selection of suitable foundation for structures based on ground conditions. Various methods of soil exploration and methods of sample collection are discussed. The procedure for collection of soil samples and in-situ tests are discussed. Analysis and design of various geotechnical structures based on the data collected from soil exploration is explained.

Course Pre/co-requisites

A8120 – Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8152.1 Compare different methods of soil exploration.
A8152.2 Illustrate different drilling methods used in subsoil exploration.
A8152.3 Choose the suitable procedure for soil sampling and preservation.
A8152.4 Analyse the data obtained from field tests.
A8152.5 Design geotechnical structures based on field test results.

3. Course Syllabus

Soil Exploration: Importance - Terminology - Planning of Ground Investigations - Stages in subsurface exploration- Reconnaissance – Preliminary Investigation – Detailed Investigation - Geophysical methods – Seismic and Electrical methods.

Boring methods: Auger, wash boring, Rotary drilling, Percussion drilling and core drilling – Probing, Trail pits, trenches, drifts and shafts - Location, spacing and depth - Stabilization of boreholes – Planning of exploration.

Sampling and sample disturbance: Methods of sampling - Types of Samples and Samplers - Design features of samplers - Area ratio – Inside and outside clearance - Cleaning of bore holes, preservation, labelling and Shipment of Samples - Design Considerations of

Open Drive Samplers. – Bore log - Preparation of Soil Report.

Field tests: Standard Penetration Test – Limitations and Corrections – Cone Penetration Test – Field Vane Shear Test – Bore Hole Shear Test – Dilatometer Test – Pressure Meter test – Field Permeability Test – Plate load test – Monotonic and Cyclic Pile load test.

Design of Geotechnical Structures based on the data from Field Tests: Standard Penetration Test – its limitations and Corrections – Cone Penetration Test – Plate load test - Field Vane Shear Test – Bore–Hole Shear Test – Dilatometer Test – Pressure Meter test – Field Permeability Test.

4. Books and Materials

Text Books:

1. Bowles, J. E., Foundation Analysis and Design, McGraw Hill Publishing Co., 5th Edition, 2001

Reference Books:

1. Hvorslev, M. J., Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes, ASCE, 1949
2. Terzaghi, K., Peck, R. B. and Mesri, G. Soil Mechanics in Engineering Practice, Wiley, 1996
3. Roy. E. Hunt, Geotechnical Investigation methods: A field Guide for Geotechnical Engineers, CRC Press, 1st Ediion, 2006
4. C. R. Clayton, M. C. Matthews and N. E. Simons, Site Investigation: A Handbook for Engineers, Wiley–Blackwell, 2nd Edition, 1995
5. Tomlinson, M. J., Foundation Design and Construction, Pearson, 2001.
6. Relevant Indian Standard Codes.

Course Structure

A8153 - Intelligent Transportation Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course presents fundamental concepts of Intelligent Transportation Systems (ITS). It develops an understanding of ITS architecture, processes and its evolution. It also gives understanding of capabilities of key technologies and impact of the technologies on different modes and movement. This course includes evaluation of ITS technologies, applications and services.

Course Pre/co-requisites

A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8153.1 Explain various ITS architectures and their functions.
A8153.2 Compare different technologies and data sources for ITS.
A8153.3 Outline features of ITS applications.
A8153.4 Make use of ITS technologies for smart cities.
A8153.5 Demonstrate various ITS case studies.

3. Course Syllabus

Introduction to ITS and ITS Architecture: Urbanization, motorization, problems and need of ITS – Architecture, functions, logical, physical, and organizational architectures, ITS architecture of US.

Technologies and Data Sources for ITS: Digital communication, telecommunication technologies, data and information processing technologies – Detection and sensing technologies, data identification and collection methods.

ITS User Services: Traffic management - objectives, measures, and use of ITS – Advanced Traffic Management System (ATMS), Advanced Traveller Information Systems (ATIS), and Advanced Vehicle Control Systems (AVCS), and Advanced Public transport Systems

(APTS), Commercial vehicle Operation (CVO), Emergency Management, Incident Management.

ITS for smart cities: Strategies and key components of Smart City, ITS Solutions, ITS Technologies – Multi-Modal Transportation and Traveller Information Systems, Smart Ticketing and Mobile Payments, Intelligent Traffic Management Systems, E-Mobility, Solar Power for Electric Vehicles (EVs) and Vehicle to Grid (V2G), Automated Highway System (AHs), and examples of Smart City Initiatives.

Case Studies: ITS International Case Studies – Dublin Bus, Italy ATAF, Zurich VBZ, Japan VICS, and London– Indian Case Studies – Mysore MCTD, Indore BRTS, Delhi DTC, Bangalore BTRAC, and Mumbai ATC.

4. Books and Materials

Text Books:

1. Pradip Kumar Sarkar & Amit Kumar Jain, Intelligent Transport Systems, PHI Learning Pvt. Ltd., Delhi, 1st Edition, 2018

Reference Books:

1. Mashrur A. Chowdhury & Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, London, 1st Edition, 2003
2. Lawrence Klein, Sensor Technologies and Data Requirements for ITS, Artech House Publishers, 1st Edition, 2001

Course Structure

A8154 - Air Pollution and Control Technologies

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is designed to provide the engineering graduates with technical expertise in air pollution and its control technologies which will enable them to address complex environmental problems related to Air pollution. This course offers a comprehensive understanding of air pollution and its control technologies, focusing on the automobile, indoor air pollution and air quality management. In this course, students will learn about Air Pollution Fundamental concepts and Global issues, Air Pollution Sampling and Measurement mechanisms, key technologies for controlling emissions of particulate matter, gaseous and hazardous emissions, Automobile, Indoor Air Pollution and management of Air quality.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8154.1 Identify sources, types and effects of Air Pollutants and Global, Meteorological Aspects of Air Pollution.
A8154.2 Interpret various methods of Air Pollution Sampling and Measurement.
A8154.3 Analyze Air Pollution Control Techniques of particulate matter, and gaseous emissions.
A8154.4 Examine Automobile and Indoor Air Pollution and its control.
A8154.5 Apply Air Quality Management strategies to minimize Air Pollution.

3. Course Syllabus

Air Pollution and Global issues: Definitions, scope, sources of air pollutants, Classification and Properties of Air Pollutants, Effects of air pollutants on man, materials and vegetation, Global effects of air pollution - Green House Effect, Heat Islands, Acid Rains, Photochemical Smog, and Ozone Depletion. Major Environmental Air Pollution Episodes. Meteorological Aspects of Air Pollution Dispersions, Temperature Lapse Rates and Stability, Plume Behaviour, Dispersion of Air Pollutants, Solutions to the Atmospheric Dispersion

Equation, the Gaussian Plume Model.

Air Pollution Sampling and Measurement: Types of Pollutant Sampling and Measurement, Ambient Air Sampling, Collection of Gaseous Air Pollutants, Collection of Particulate Pollutants, Stack Sampling, Analysis of Air Pollutants - Sulphur Dioxide, Nitrogen Dioxide, Carbon Monoxide, Oxidants and Ozone, Particulate Matter.

Air Pollution Control Techniques: Source Correction Methods, Control of Particulate Emission: Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers, Selection of a Particulate Collector.
Control of Gaseous Emission: Adsorption by Solids, Absorption by Liquids, Combustion - Behaviour and Fate of Air Pollutants.

Automobile and Indoor Air Pollution: Vehicular pollution – Sources and types of emission, Alternate fuels and emissions, Emission controls and standards, Strategies to control automobile pollution, impact of electric and hydrogen vehicles on automobile pollution. Definition and Sources of Indoor air pollution, factors influencing Indoor air quality, control of indoor pollution by plants and air cleaning systems, Standards of indoor air quality.

Air Quality Management: Air quality standards. Air quality Index and limits, Air quality monitoring, Air pollution Preventive measures, Air pollution control efforts - Zoning, Town planning, regulation of new industries, Legislation and enforcement, Environmental Impact Assessment.

4. Books and Materials

Text Books:

1. Y. Anjaneyulu, Air Pollution: Prevention and Control Technologies, $2^n d$ Edition, BS Publications, 2020
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Education, 3rd Edition, 2017
3. C. S. Rao, Environmental Pollution control Engineering, New age international, 3rd Edition, 2018

Reference Books:

1. K.V.S.G. Murali Krishna, Air Pollution and Control USP Publishers, 1st Edition, 2015
2. Daniel A. Vallero, Fundamentals of Air Pollution, Elsevier Publishers, 4th Edition, 2007

Course Structure

A8155 - Green Building and Sustainability

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces concepts of sustainability in the context of construction building materials. It also discusses the role of low carbon cements and recycled aggregate in minimizing consumption of natural resources. The course also emphasizes the concepts of embodied, operational, life cycle energy and minimizing energy consumption. It also intends to make students aware of rating systems like LEED, GRIHA etc.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8155.1 Identify green building and green building materials.
A8155.2 Make use of different rating agencies to classify the type of building.
A8155.3 Analyze sustainability and its implications for the practice of engineering.
A8155.4 Evaluate the potential of the alternative construction materials for sustainability.
A8155.5 Examine the green building rating systems and its contribution to sustainability.

3. Course Syllabus

Green Building: Concept of Green building, Principles of green buildings, Eco-friendly materials, Certification systems – Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED).

Green Building Materials: Green Building Materials and Equipment in India, what are key requisites for Constructing a Green Building, Important Sustainable features for Green Building. **Building Services:** Fire protection – classes of fire and causes, development of fire, fire resisting materials, means of escape, Standing Fire Advisory Council norms. Water supply -Water distribution and plumbing fixtures.

Applications in the Built Environment: Concepts of green buildings, climate responsive building - Reduction of energy consumption, direct and indirect methods - Reduction of water consumption, direct and indirect methods - Carbon footprint and eco footprints of buildings - New concepts and trends in green buildings, national and international.

Sustainability: The Concept of Sustainability; Definition of Sustainability, Dimension of Sustainability. Three Pillars of Sustainability, Principles of Sustainability - 5R, Construction Materials Resource Efficiency, Operational Reuses of the Construction Materials, Sustainability Goals for construction Industry.

Sustainability in Built Environment: Environmentally sensitive design, low impact development, green infrastructure and conservation design, Green buildings and land use planning, Energy use and buildings.

4. Books and Materials

Text Books:

1. Frederick S. Merritt, Jonathan T. Ricketts, Building design and construction Handbook, McGraw-Hill Inc., 5th edition,1994.
2. Fred hall and Roger Greeno, Building Services Handbook, Routledge, 7th edition, 2013.
3. Bradley A. Striebig, Adebayo A. Ogundipe and Maria Papadakis, Engineering Applications in Sustainable Design and Development, 1st edition, 2016.

Reference Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

Course Structure

A8156 - Advanced Geotechnical Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces soil exploration methods and fundamental theories of foundation engineering. The main objective is to introduce principles of shear strength theory, analysis and design of foundations of various Civil Engineering structures like buildings, bridges, and retaining structures etc. Different problems encountered within the soil masses manifested as slope failure, foundation failure etc. are explained using theories of earth pressure and slope stability analysis.

Course Pre/co-requisites

A8120 - Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8156.1 Compare different soil exploration methods.
A8156.2 Assess stability of slopes using theories of slope failures.
A8156.3 Determine earth pressures in retaining structures.
A8156.4 Evaluate the settlement of shallow foundations and pile foundations.
A8156.5 Estimate bearing capacity of soil in shallow foundations and pile foundations.

3. Course Syllabus

Soil Exploration: Need – methods of soil exploration – boring and sampling methods – penetration tests – plate load test– planning of soil exploration programme, Bore logs and preparation of soil investigation report.

Slope Stability: Infinite and finite earth slopes – types of failures – factor of safety of infinite slopes – stability analysis by Swedish slip circle method, method of slices, Bishop's Simplified method of slices – Taylor's Stability Number- stability of slopes of earth dams under different conditions.

Earth Pressure Theories: Active, Passive and at rest soil pressures Rankine's theory of earth pressure – earth pressures in layered soils – Coulomb's earth pressure theory.
Retaining Walls: Types of retaining walls, filter material for drainage.

Shallow Foundations: Types - choice of foundation – location and depth - safe bearing capacity – shear criteria – Terzaghi's, and IS code methods - settlement criteria – allowable bearing pressure based on SPT N value and plate load test – allowable settlements of structures.

Pile Foundation: Types of piles – load carrying capacity of piles based on static pile formulae – dynamic pile formulae - pile load tests - load carrying capacity of pile groups in sands and clays – Settlement of pile groups – negative skin friction.

4. Books and Materials

Text Books:

1. Narasinga Rao B.N.D., Soil Mechanics and Foundation Engineering, Wiley Publishers, 2019
2. Murthy V. N. S., Soil Mechanics and Foundation Engineering, CBS Publishers and Distributors, 1st Edition, 2018

Reference Books:

1. Braja M. Das, Principles of Geotechnical Engineering, Cengage Learning, 8th Edition, 2015
2. Ranjan, G., and Rao, A. S. R., Basic and Applied Soil Mechanics, New age International Pvt. Ltd, 4th Edition, 2022

Course Structure

A8157 - Pavement Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course begins with the introduction of different types of pavement structures, and various factors to be considered in the analysis and design of pavements. Subsequently, discusses about different theories to be followed in estimating critical strains and stresses in flexible ae well as rigid pavement designs. Then, it discusses about codal practice guidelines in flexible and rigid pavement designs. Finally, the course covers different types of pavement construction and maintenance techniques.

Course Pre/co-requisites

A8103 - Applied Mechanics

A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8157.1 Utilize materials characteristics in the design and construction of pavements.
A8157.2 Analyze the stresses induced in various layers of the pavements.
A8157.3 Evaluate various types of pavement failures and their stability.
A8157.4 Discuss construction of bituminous and cement concrete pavements.
A8157.5 Design flexible and rigid pavements along with their joints.

3. Course Syllabus

Factors Influencing Pavement Design: Types of pavements, Factors affecting design of pavements, wheel loads, tyre pressure, contact pressure, Material characteristics. Environmental and other factors. Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane Distributions & Vehicle Damage Factors.

Flexible Pavements: Flexible pavement, One-layer system, Burmister's Theory - two-layer and multi-layer system of analysis. IRC guidelines for Flexible Pavement design using RAP, and AASHTO Method of Flexible Pavement Design.

Rigid Pavements: Relative stiffness of slab, modulus of sub-grade reaction, stresses due to wheel load, temperature, deflection and friction. IRC guidelines for Rigid Pavement design, Design of Joints in Rigid Pavements, Types of Joints, Use of Tie Bars and Dowell Bars.

Highway Construction: Requirements of materials such as Soil, Aggregate and Bitumen, Marshall's Method of Bituminous Mix design. Highway construction – WBM Roads, WMM, Types of Bituminous Constructions, Seal, Prime and Tack Coats - Cement Concrete Roads, White topping Road and Its Types – Material specifications According to MORT&H.

Highway Maintenance: Need for Highway Maintenance, Pavement Failures - Failures in Flexible Pavements, Types and Causes - Rigid Pavement Failures - Types and causes - Pavement Evaluation, Benkelman Beam method, FWD - Strengthening of Existing Pavements - Types of Overlays, Suitability, Design of Overlays.

4. Books and Materials

Text Books:

1. S. K. Khanna, C. E. G. Justo, and A. Veeeraraghavan, Highway Engineering, 10th Edition, Nemchand & Bros, New Delhi, India, 2014
2. L. R. Kadiyali and N. B. Lal, Principles and Practices of Highway Engineering, 7th Edition, Khanna Publishers, New Delhi, India, 2013

Reference Books:

1. E. J. Yoder and M. W. Witczak, Principles of pavement design, 22nd Edition, Wiley, 2001
2. Yang H Huang, Pavement Analysis and Design, 2nd Edition, Pearson, 2008
3. IRC 37-2018: Guidelines for the Design of Flexible Pavements (Fourth Revision), Indian Roads Congress, New Delhi
4. IRC 58-2015: Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision), Indian Roads Congress, New Delhi
5. IRC 82-2015: Code of Practice for Maintenance of Bituminous Road Surfaces (First Revision)

Course Structure

A8158 - Watershed Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The main objective of the Watershed Management course is to cover various aspects of water resource development and management from a watershed perspective. This course introduces fundamental concepts and practices of Watershed Management. In this course, students will get a comprehensive understanding of basic concepts of watershed management, watershed hydrology and watershed delineation. The course will also be dealing about the watershed delineation, water harvesting, and sustainable watershed management.

Course Pre/co-requisites

A8119 - Water Resources Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8158.1 Make use of basic concepts and knowledge on Watershed Management.
A8158.2 Analyze soil erosion and soil conservation methods for Watershed Management.
A8158.3 Apply suitable techniques for watershed delineation.
A8158.4 Select water harvesting techniques for sustainable watershed management.
A8158.5 Utilize proper management techniques for different lands.

3. Course Syllabus

Basic Concepts of Watershed Management: Concept of watershed, classification of watersheds, characteristics of watershed, objectives of watershed management, need for watershed management, Factors affecting watershed management, Sustainable integrated watershed management, social aspects of watershed management.

Principles of Soil Erosion: Types and causes of erosion, factors affecting erosion, estimation of soil loss due to erosion from watersheds - Universal soil loss equation. Methods of soil conservation – structural and non-structural measures.

Watershed Delineation: Runoff computations from a watershed, flow frequency analysis, Gumbel's, Log-Pearson and Weibull's methods of analysis, planning of watershed management activities, peoples' participation, preparation of action plan, administrative requirements.

Water Harvesting: Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures. Artificial recharge of groundwater in small watersheds, methods of artificial recharge.

Land Management: Land use and Land capability classification, management of for est, agricultural area, and grasslands, land grading operation, Reclamation of saline and alkaline soils. Micro farming, biomass management on the farm.
Wasteland management: Definition, concept and types of wastelands, factors responsible for land degradation, characteristics of wasteland, Problems of degraded land, Wasteland management techniques.

4. Books and Materials

Text Books:

1. JVS Murthy, Watershed Management, New Age International Publishers, 2nd Edition, 2017
2. Murthy, V.V.N. and M.K. Jha Land and Water Management, Kalyani Publishers, 7th Edition, 2015

Reference Books:

1. Madan Mohan Das and M.D. Saikia, Watershed Management , Prentice Hall of India, 1st Edition, 2013
2. R Suresh. Watershed Hydrology, Standard Publishers and Distributors, Delhi, 2nd Edition, 2007
3. Common Guidelines for Watershed Development Projects, Government of India, 2008

Course Structure

A8159 - Repair and Rehabilitation of Structures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course introduces the concept as well as techniques associated with repairs and rehabilitation of existing structures. The course enables the students to understand the functionality of any structures depends on various factors during its life time. The theoretical knowledge of rehabilitation will enable students to develop skills to carry out repairing or retrofitting of existing structure. The course also discusses the modern tools/instrumentation to measure the level of damage or strength present in the structure.

Course Pre/co-requisites

A8105 - Building Construction and Planning

A8114 - Concrete Technology

A8118- Design of Reinforced Concrete Structures

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8159.1 Illustrate various maintenance and repair strategies.

A8159.2 Categorize the causes and prevention mechanisms of corrosion and damages occur in structures.

A8159.3 Apply various methods and techniques for damage assessment and diagnosis.

A8159.4 Formulate the usage of different techniques for structural retrofitting.

A8159.5 Estimate the structural damage and recommend suitable repair and strengthening methods.

3. Course Syllabus

Causes of Deterioration and Durability Aspects: Holistic Model for Deterioration of RCC; Permeability of Concrete: Capillary Porosity, Air Void, Micro and Macro Cracks; Aggressive Deteriorating Chemical Agents: Corrosion of reinforcing bars, Sulphate Attack, Alkali Silica Reaction, Intrinsic and Extrinsic Causes and Stages of Distress.

Condition Survey & Non-Destructive Evaluation: Definition, Objective, Stages, Consideration for Repair Strategy.
Non-Destructive Evaluation Tests: Concrete Strength Assessment: Rebound Hammer Test, Ultrasonic Pulse Velocity (UPV) Test, Pull-out (LOK) Test, Core Sampling and Testing; Chemical Tests: Carbonation Test, Chloride Content; Corrosion Potential Assessment.

Selection of Repair Materials: Essential Parameters for Repair Materials.
Materials for Repair: Premixed Cement Concrete/Mortars, Cements, Mineral and Chemical Admixtures, Water Cement Ratio; Epoxies and Epoxy Systems including Epoxy Mortars/Concretes: Epoxies, Modifies Epoxy Systems.

Repair Methods: Repair options; Performance Requirements of Repair Systems; Important factors to be considered for Selection of Repair Methods; Repair Stages; Repair Methods: Repairs using Mortars, Dry Pack and Epoxy Bonded Dry Pack, Pre-placed Aggregate Concrete (PAC), Shotcrete, Concrete Replacement, Epoxy Bonded Concrete.

Rehabilitation Strategies: Ferro-cement, Plate Bonding, RCC Jacketing, Propping and Supporting, Fibre Wrap Technique. Repair/Rehabilitation Strategies – Stress Reduction, Repair/Strengthening of Columns, Beams and Slabs, Compressive Strength of Concrete, Cracks/Joints, Masonry, Protection.

4. Books and Materials

Text Books:

1. CPWD Hand book on Repair and Rehabilitation of RCC Buildings, NDLS 2008.
2. Santhakumar, A.R., Concrete Technology, Oxford University Press, New Delhi, 2007.

Reference Books:

1. Edwards, S.C., Shaw, J.D.N. and Allen, R.T., Repair of Concrete Structures, Span Press, GW, UK, 1993.
2. Jacob Feld and Kenneth L. Carper, Structural Failures, John Wiley & Sons, NY. US,1997.

Course Structure

A8160 - Ground Improvement Techniques

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces different methods for densification of cohesionless and cohesive soils. Discusses different methods of stabilization of soils and the effects of admixture on soil properties. Outline different methods of dewatering and demonstrate its applications in engineering projects. Describes different methods of grouting and highlight the use of grouting in dams and tunnels. Illustrate functions of stone, lime, granular piles, soil reinforcement - geosynthetics, anchors, nails and tiebacks in soil improvement.

Course Pre/co-requisites

A8120 - Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8160.1 Illustrate different densification methods for cohesive and cohesionless soils.
A8160.2 Identify suitable geosynthetic material for mechanically stabilized earth walls.
A8160.3 Outline influence of admixtures on properties of stabilized soil.
A8160.4 Examine principles of dewatering and grouting in dams and tunnels.
A8160.5 Make use of stone columns and soil nailing in stabilization of trenches.

3. Course Syllabus

Introduction: Need for Engineering Ground – Classifications of Ground Modification Techniques – Suitability, Feasibility and Desirability.

Densification of cohesionless soils: Deep Compaction – Vibroflotation - Blasting – Densification at ground - Vibrocompaction - Heavy Tamping

Improvement of Cohesive soils: Preloading - Soil Replacement – Radial Consolidation – Vertical and Radial Consolidation - Vertical Drains – Sand Drains – Effect of Smear – Sandwicks – Band drains.

Geosynthetics: Types, functions. Properties and applications of geotextile, geogrid, geocell and geomembrane.

Mechanically Stabilized Earth walls: Types, Components of MSE walls, Applications.

Stabilisation: Stabilisation - Mechanical Stabilisation – Rothfuch's Graphical method, Lime Stabilisation, Cement Stabilisation, Bitumen Stabilisation, Thermal Stabilisation and Chemical Stabilisation.

Dewatering: Dewatering methods – open sumps and ditches – gravity flow wells – Vacuum dewatering – Electroosmosis

Grouting: Overview of grouting - Suspension grouts – Solution grouts – Emulsion grouts – Grouting Techniques – ascending and descending stage – Grouting Plant - Grout control - Grouting applications – Dams, Tunnels, excavations.

Stone Columns: Stone Columns – Methods of installation of Stone Columns – Load shared by stone columns and the stabilized ground – uses of stone columns - Lime columns and granular trenches – Installation – In situ ground reinforcement – ground anchors – types – Components and applications – Soil nailing and its applications.

4. Books and Materials

Text Books:

1. Purushothama Raj P, Ground Improvement Techniques, Laxmi Publications, 2nd Edition, 2016
2. Hausmann, M. R., Engineering Principles of Ground Modifications, McGraw Hill publications, 1990

Reference Books:

1. Manoj Datta and S Gulhati – Geotechnical Engineering - McGraw Hill Education, 2017
2. Koerner, R. M., Designing with Geosynthetics – Prentice Hall, New Jersey, 1994
3. M. P. Moseley and K. Krisch, Ground Improvement, II Edition, Taylor and Francis, 2006

Course Structure

A8161 - Traffic Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The purpose of the course is to introduce the students on traffic flow modelling and design of various traffic regulatory and control measures. Specifically, the course covers traffic flow modeling by means of vehicle arrival and car following models at microscopic level and traffic stream models at macroscopic levels. Subsequently, it discusses about measurement of various traffic flow parameters, analyzing operational performance by capacity and level of service, and design of various control measures at signalized intersections.

Course Pre/co-requisites

A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8161.1 Discuss various traffic flow and measurement principles.
A8161.2 Model traffic flow at microscopic and macroscopic level.
A8161.3 Analyze operational performance of various traffic facilities.
A8161.4 Estimate various traffic flow parameters.
A8161.5 Design various traffic control and management measures.

3. Course Syllabus

Macroscopic Traffic Flow: Macroscopic traffic flow parameters, relationships, and fundamental diagrams - Greenshields's model, Greenberg's logarithmic model, Underwood's exponential model, pipe's generalized model, multi-regime models, Moving observer method.

Microscopic Traffic Flow: Car-following models - Concept of stimulus-response, general motor's models - Vehicle arrival models - Poisson distribution, headway modeling, random vehicle generation – Microscopic traffic simulation - Vehicle generation, trajectories, and operational models.

Traffic Measurement: Travel time and delay studies; Intersection studies; Vehicle detection methods - GPS, Instrumented Vehicles, Image Processing, ILD, Bluetooth, Infrared methods - Parking – on-street and off-street parking systems, parking surveys, demand estimation, operational parameters and Transportation System Management measures.

Capacity Analysis: Heterogeneous traffic, vehicle types, dynamic PCU, stream equivalency factor - Capacity and LOS - Definitions, factors affecting LOS – Capacity, operational performance measures, and Level of Service of urban roads, multi-lane highways, roundabouts, signalized and unsignalized intersections as per Indo-HCM.

Intersection Control: - Definitions, saturation flow, lost time, critical flows - Design principles of a traffic signal - Phase design, cycle time determination, green splitting, stopped and control delay, Webster's delay model - Coordinated traffic signal - Concepts of offset, common cycle length bandwidth, offset for one-way and two-way streets – Traffic responsive control – Remote based, Vehicle actuated and Adaptive Traffic Signals.

4. Books and Materials

Text Books:

1. Roess, R. P., Prassas, E. S. & McShane, W. R., Traffic Engineering, 5^{th} Edition, Pearson, 2020
2. May, A. D., Traffic Flow Fundamentals, 2^{nd} Edition, Prentice Hall, 1990

Reference Books:

1. Indian Highway Capacity Manual (Indo-HCM), CRRI, New Delhi-110025, 2017
2. Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice-Hall, India, 1987
3. Kadiyali, L. R., Traffic Engineering and Transportation Planning, 8^{th} Edition Khanna Publishers, India, 2013
4. Papacostas, C. S. and Prevedouros, P.D., Transportation Engineering and Planning, 3^{rd} Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2009

Course Structure

A8162 - Groundwater Hydrology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is aimed to offer engineering graduates with technical knowledge in Engineering Hydrology, allowing them to pursue a career and professional accomplishment in the public or private sector by addressing the complexities of real-world Engineering Hydrology issues. This course on Groundwater Hydrology focuses on groundwater occurrence, Groundwater Hydraulics and Groundwater Exploration. It also provides comprehensive knowledge on groundwater management, pollution and modelling. There is a strong emphasis on engineering decision making throughout the course.

Course Pre/co-requisites

A8119 - Water Resources Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8162.1 Utilize knowledge of groundwater resources to estimate aquifer parameters.
A8162.2 Determine flow of groundwater and yield towards a well in aquifers.
A8162.3 Analyze groundwater exploration techniques by using geophysical methods to explore groundwater.
A8162.4 Apply suitable management techniques for groundwater and coastal aquifers.
A8162.5 Examine groundwater pollution, control and modeling techniques of the aquifer.

3. Course Syllabus

Groundwater Occurrence: Groundwater hydrologic cycle, origin and sources of groundwater, rock properties effecting ground water, vertical distribution of groundwater, zone of aeration and zone of saturation, geologic formation as aquifers, porosity, specific yield and specific retention. groundwater movement, permeability, Darcy's law, storage coefficient, transmissivity, differential equation governing groundwater flow in three dimensions derivation, groundwater flow equation in polar coordinate system, groundwater flow contours and their applications.

Groundwater Hydraulics: Derivation of basic differential equation and its solutions, steady and unsteady radial flow of groundwater towards a well in confined and unconfined aquifers, analysis of pumping test data, Theis type curve method, Jacob's method for time and distance drawdown tests, open well hydraulics, recuperation test.

Groundwater Exploration: Electrical methods, expression for apparent resistivity in four electrode arrangements - Werner, Schlumberger arrays, field surveys, interpretation techniques in sounding and profiling for groundwater investigation. Seismic refraction method - principle and propagation of refracted energy in two and three media earth, field procedure and interpretation techniques.

Groundwater Management: Water balance studies, perennial yield, concept of artificial recharge, various types of artificial recharge techniques, conjunctive use of surface and groundwater, management of coastal aquifers – Ghyben-Herzberg relation, upconing of saline water, methods of control of salt-water intrusion. Applications of GIS and RS in artificial recharge of ground water along with case studies.

Groundwater Pollution and Modelling: Groundwater quality, groundwater pollution, elements and source of pollution, their effects and remedial measures. Aquifer modeling - electrical analogue models, RC network techniques, principles of digital modeling of aquifers, flow modeling using finite difference methods and finite element methods, advection process, diffusion and dispersion process, solute transport modeling.

4. Books and Materials

Text Books:

1. David K. Todd, Larry W. Mays, Groundwater Hydrology, John Wiley & Sons, 3rd Edition, 2011
2. H.M.Raghunath, Groundwater Hydrology, Wiley Eastern Limited, 3rd Edition, 2007
3. A.K. Rastogi, Numerical Groundwater Hydrology, Reprint, Penram International Publishing, 2012

Reference Books:

1. K. R. Karanth, Groundwater Assessment, Development and Management, 1 ^{s}t Edition, McGraw Hill Publications, 1987.
2. C.W. Fetta, Applied Hydrogeology, CBS Publishers & Distributors, 3rd Edition, 2007

Course Structure

A8163 - Elements of Earthquake Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course enables students to learn fundamental concepts of seismology and earthquake resistant design in earthquake engineering. The students can learn origin of earthquake its causes, its measurement and its effects on structures. The course also introduces the concept of response spectra and its use in seismic analysis. Towards the end two basic methods of seismic analysis as per IS 1893 (Part-I) are discussed.

Course Pre/co-requisites

A8115 - Structural Analysis

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8163.1 Explain the fundamental concepts of seismology.
A8163.2 Summarize earthquake ground motion recording and their characteristics.
A8163.3 Illustrate characteristics of response spectra and its types.
A8163.4 Outline concept of earthquake resistant design and its virtues.
A8163.5 Analyze the given structure for seismic loads as per IS 1893 Part-I.

3. Course Syllabus

Engineering Seismology: Origin of earthquakes, Engineering geology, Seismicity of the world, Faults, Propagation of earthquake waves. Quantification of earthquake (magnitude, energy, intensity of earthquake).

Measurements of Earthquake: Accelerograph, Accelogram recording, Determination of magnitude, Epicentral distance, focal depth, etc. Ground motion and their characteristics, Factors affecting ground motions.

Concept of Response Spectra: Generation of Site-Specific Spectrum, Estimation of PGA, Earthquake Design Spectrum and Inelastic Spectra.

Concept of Earthquake-Resistant Design: Design philosophy, Four virtues of EQRD: Stiffness, Strength, ductility and Configurations; Building Configuration-Problems and solutions; Building characteristics – Mode shape and fundamental period.

Seismic Analysis of structures: Seismic analysis methods, Introduction to IS:1893 (Part-1), Determination of lateral forces as per IS 1893 (Part 1) – Equivalent static method and Response Spectrum Method.

4. Books and Materials

Text Books:

1. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall of India, 1st Edition, 2006
2. Duggal, Shashikant K, Earthquake resistant design of structures, Oxford university press, 2nd Edition, 2013

Reference Books:

1. Mario Paz, International Handbook of Earthquake Engineering: Codes Programs and Examples, Springer Verlag, 1st Edition, 2020.
2. Okamoto, S. Introduction to Earthquake Engineering, University of Tokyo press, 2nd Edition, 1984

Course Structure

A8164 - Environmental Geotechnology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course deals with important concepts and principles of Environmental Geotechnology. Describes the waste disposal facilities and existing disposal facilities. Emphasizes the fundamental aspects of Contaminant transport and stabilization of solid waste. Illustrates the process of rehabilitation of waste dumps and geotechnical reuse of waste.

Course Pre/co-requisites

A8120 - Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8164.1 Assess the extent of contamination in the soil.
A8164.2 Categorize waste disposal methods.
A8164.3 Compare transportation mechanism of contaminants .
A8164.4 Utilize the solid waste for soil improvement.
A8164.5 Select suitable remediation methods based on contaminant type.

3. Course Syllabus

Introduction to Environmental Geotechnology: Environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction – failures of foundations due to pollutants.

Safe disposal of waste: Site selection for landfills – characterization of landfill sites – rigid or flexible liners - waste characterization – current practice of waste disposal – Monitoring facilities - passive containment system – application of geosynthetics in solid waste management.

Transport of Contaminants: Contaminant transport in the subsurface – advection – diffusion – dispersion – contaminant transformation – sorption – biodegradation – ion exchange – precipitation - Hydrological consideration in landfill design.

Stabilization: Solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation- detoxification – mechanism of stabilization – organic and inorganic stabilization – utilization of solid waste for soil improvement.

Remediation of Contaminated Soils: Ex-situ and In-situ remediation Solidification, bio-remediation, incineration, soil washing, Phyto remediation, soil heating, vetrification, bio-venting.

4. Books and Materials

Text Books:

1. Hari D. Sharma and Krishna R. Reddy, Geo-Environmental Engineering, John Wiley and Sons, INC, USA, 2004.
2. Fang, Hsai-Yang, and Ronald C. Chaney, Introduction to Environmental Geotechnology, CRC Press, 2016.

Reference Books:

1. Manoj Datta, Waste Disposal in Engineered landfills, Narosa Publishing House, 1997.
2. Daniel B.E., Geotechnical Practice for waste disposal, Chapman & Hall, London 1993.
3. Westlake, K, Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Ott, W.R., Environmental indices, Theory and Practice, Ann Arbor, 1978.

Course Structure

A8165 - Railway, Airport, Waterway and Harbour Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course deals with the introduction of railway and airway engineering. It begins with the discussion of railway track features, its geometric design, and interlocking of signals. Subsequently it introduces about development of air transport, airport planning, zoning laws, airport markings, lighting, and air traffic control aids. Finally, it discusses about water transport features and operational facilities.

Course Pre/co-requisites

A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8165.1 Distinguish between railway, airway, and waterway transportation features.
A8165.2 Identify and plan an airway and waterway facilities for a given region.
A8165.3 Analyze various forces acting on the railway vehicles.
A8165.4 Explain airport zoning laws, airport features, and air traffic control.
A8165.5 Design geometry of railway track and runway features.

3. Course Syllabus

Rail Transport: Role of railways in transportation, Advantages of Railways - Permanent Way - Permanent way components - Types of Gauges - Coning of Wheels - Creeps and kinks - Sleeper density – Track circuiting.

Geometric Design: Degree of Curve - Speed on curves - Widening of gauges in curves – Cant and Negative Super elevation – Points, Crossings – Classification of Signals – Control of movement of trains - Interlocking of Points and Signals.

Air Transport: History of air transport – Directorate of Civil Aviation, National airports Authority - Airport Planning - Master plan - Site selection - Airport Obstructions - Runway Orientation, Basic Runway length and Corrections – Airport Capacity.

Airport Layout and Air Traffic Control: Terminal, Parking, Apron, Hangar Areas and Airport Layouts - Runway and Taxiway Markings, Wind Rose Diagram - Runway and Taxiway Lightings - Air Traffic Control - Enroute and Landing Air traffic Control Aids.

Water Transport: History and modern trends of waterway transportation, Harbours, Ports, Docks, Tides and Waves, Classification of Harbours, requirements of ports and major facilities - Protection facilities – Breakwater and its types, Docking facilities – Wet docks – Dry docks and its types, Navigation facilities – Light House and mooring accessories.

4. Books and Materials

Text Books:

1. S. C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai Publishing Co Pvt Ltd, New Delhi, 6th Edition, 2010.
2. S. K. Khanna, M. G. Arora, and S. S. Jain, Airport Planning and Design, Nemchanad and Brothers, Roorkee, 6th Edition, 2017.
3. S. P. Bindra, A Course in Docks and Harbour Engineering, Dhanpat Rai and Sons, New Delhi, 1st Edition 2012.

Reference Books:

1. S. P. Chandola, A Text Book of Transportation Engineering, S. Chand & Company Pvt. Ltd., New Delhi, 1st Edition, 2014.
2. R. Srinivasan, "Harbour, Docks and Tunnel Engineering", Charotar Publishing home, 27th Edition, 2015.

Course Structure

A8166 - Environmental Impact Assessment

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the methodology of environmental impact assessment (EIA) which is a vital tool for sound environmental management and decision-making. This course provides an overview of the concepts, methods, issues and various forms and stages of the EIA process. This course deals with the identification, prediction and assessment of impacts on air, water, soil, biological, vegetation and wildlife and selection of appropriate mitigation measures. This course also provides comprehensive knowledge on Environmental Auditing, Concept of ISO – 14000, Environmental Legislation and Life Cycle Assessment of materials in relation to EIA.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8166.1 Build knowledge on basic concepts and methodologies of Environmental Impact Assessment.

A8166.2 Identify and predict the impacts of developmental activities on air, water, soil, biological, vegetation and Wildlife.

A8166.3 Assess the impacts on air, water, soil, biological, vegetation and wildlife and select appropriate mitigation measures.

A8166.4 Develop environmental audit in view of ISO-14000 standards for Environmental Impact assessment.

A8166.5 Analyze the implications of current environmental legislation and Life cycle of materials in relation to EIA.

3. Course Syllabus

Basic Concepts of EIA: EIA definition, scope and advantages, Initial environmental Examination, Elements of EIA, factors affecting EIA Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.

EIA Methodologies: Introduction, Criteria for the selection of EIA Methodology, EIA

methods, Ad-hoc methods, matrix methods, Network method, Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

Assessment of Impact of Developmental Activities and Land Use: Methodology for the Assessment of Soil and Groundwater, Delineation of Study Area, Identification of Activities, Description of Existing Soil/Groundwater Resources Soil Characteristics, Procurement of Relevant Soil Quantity, Assessment of Impact Significance on landfills and human habitation.

Environmental Impact Assessment of Water, Air & Biological Environment: Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures. EIA of surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment.
Environmental Impact Assessment of Vegetation & Wild Life: Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation, Causes and effects of deforestation.

Environmental Auditing: Environmental Audit, objectives of Environmental Audit, Types of environmental Audit, stages of Environmental Audit, onsite activities, evaluation of Audit data, preparation of Audit report and Post Audit activities. Concept of ISO and ISO 14000. Case studies and preparation of Environmental Impact assessment statement for various Industries.

Environmental Legislation and Life Cycle Assessment: Environmental laws and protection acts, Constitutional provisions-powers and functions of Central and State government, The Environmental protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Guidelines for control of noise, loss of biodiversity, solid and Hazardous waste management rules. Life cycle assessment - Life cycle analysis, Methodology, Management, Flow of materials-cost criteria case studies.

4. Books and Materials

Text Books:

1. Y. Anjaneyulu, Environmental Impact Assessment Methodologies, B.S. Publication, Hyderabad, 2011
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002

3. H.S. Bhatia, Environmental Pollution and Control, Galgotia Publications Pvt. Ltd, 2018

Reference Books:

1. M.Anji Reddy, Textbook of Environmental Science & Technology, BS Publications, 2010
2. Suresh K. Dhaneja, Environmental Science and Engineering, S.K. Katania & Sons Publication, New Delhi, India, 2009
3. Larry W. Canter, Environmental Impact Assessment, Tata McGraw Hill, New Delhi, India, 1997

Course Structure

A8167 - Prestressed Concrete Structures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course offers concepts of prestressing of concrete by giving basic idea about pre and post tensioning systems and general principles. Different methods of prestressing like Hoyer and Freyssinet systems along with the losses in prestress due to secondary stresses are discussed. Analysis and design of prestressed beams for flexure and shear conditions under straight, concentric, eccentric, bent and parabolic tendons are elaborated. Analysis of anchorage stresses and stress distribution in the PSC members are highlighted.

Course Pre/co-requisites

A8118 - Design of Reinforced Concrete Structures

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8167.1 Apply the principles of prestressing for different types in practice.
A8167.2 Evaluate the stress, deflections, flexural and shear strength for prestressing elements.
A8167.3 Design tension and compression members of prestressed structures.
A8167.4 Make use of the concepts of prestress in analyzing the prestressed End blocks.
A8167.5 Analyze short and long term deflections of prestressed concrete beams.

3. Course Syllabus

Introduction: Historic development General principles of prestressing, pretensioning and post tensioning advantages and limitations of prestressed concrete, Materials, High strength concrete and high tensile steel their characteristics. I.S. Code provisions, Methods and Systems of Prestressing; Pre- tensioning and post tensioning methods, Analysis of post tensioning. Different systems of prestressing like Hoyer System, Magnel System Freyssinet system and Gifford–Udall System.

Losses of Prestress: Loss of prestress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete,

Relaxation of steel, slip in anchorage bending of member and frictional losses.

Analysis of Sections for Flexure: Elastic analysis of concrete beams prestressed with straight, concentric, eccentric, bent and parabolic tendons.

Design of Sections for Flexure and Shear: Allowable stress, Design criteria as per I.S.Code. Elastic design of simple rectangular and I-section for flexure, shear, and principal stresses, design for shear in beams, Kern- lines, cable profile.

Analysis of End Blocks: Analysis of end blocks by Guyon's method and Mugnel method, Anchorage zone trusses, approximate method of design, Anchorage zone reinforcement, Transfer of prestress pre- tensioned members.

Deflections of Prestressed Concrete Beams: Importance control of deflection, factors influencing deflections, short term deflections of uncracked members' prediction of long-term deflections.

4. Books and Materials

Text Books:

1. Krishna Raju, Prestressed Concrete, Tata McGraw-Hill Publications, 6th Edition, 2018
2. S. Ramamrutham, Pre stressed Concrete, Dhanpat Rai & Sons, New Delhi, 5th Edition, India, 2013

Reference Books:

1. N. Rajagopalan, Prestressed Concrete, Alpha Science International Ltd., 2nd Edition, 2005.
2. Lin T.Y. and Ned H. Burns, Design of Prestressed concrete, 3rd Edition, Wiley, 2013.
3. P. Dayaratnam and P. Sarah, Prestressed Concrete Structures, 7th Edition, MEDTECH, 2018.

Course Structure

A8168 - Geotechnical Earthquake Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course outlines the causes, terminology and effects of earthquakes. Describe the methods to measure the dynamic properties of soil. Illustrate the application of the seismic properties in slope stability, retaining walls and shallow foundations. Explain the causes, effects and remedies of liquefaction susceptibility of soil.

Course Pre/co-requisites

A8120 - Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8168.1 Identify causes of earthquakes.
A8168.2 Interpret characteristics of ground motion parameters and response spectra.
A8168.3 Summarize liquefaction and its effects and remedies.
A8168.4 Determine dynamic soil properties and study their response in one dimensional analysis.
A8168.5 Evaluate seismic stability of slopes, retaining walls, bearing capacity and settlement of foundations.

3. Course Syllabus

Earthquake Seismology: Introduction - Seismic waves - Causes of earth quake - Continental drift and Plate tectonics – Earthquake fault sources – Faults, fault geometry, fault movement - Elastic Rebound Theory – Location of Earth Quakes - Quantification of Earthquakes – Intensity and magnitude – Earthquake Energy.

Earthquake ground motion: Seismograph - Characteristics of Ground motion: - Ground motion parameters – Amplitude Parameters – peak acceleration, peak velocity, peak displacement other amplitude parameters – Frequency content parameters – ground response spectra, Fourier spectra, Power spectra, response spectra – spectral parameters – duration. Local site Specification and Code based design.

Dynamic Soil Properties: Representation of Stress conditions by the Mohr Circle – Measurement of Dynamic properties – field, laboratory, interpretation of observed ground response - One dimensional response analysis - linear approach, Equivalent linear approach.

Liquefaction and Lateral Spreading – Liquefaction related phenomena - Liquefaction susceptibility – Initiation of Liquefaction – Effects of Liquefaction – Remedies on Seismic hazards – Densification – Reinforcement – Grouting and mixing Techniques – Drainage Techniques.

Seismic Design of Foundation, Slopes and Retaining Structures: Seismic Design requirements for Foundation – Seismic Bearing capacity - Seismic Settlement - Internal stability and weakened instability of slopes - Seismic design of retaining walls: Dynamic Response of Retaining walls - Seismic Displacement of Retaining walls - Seismic Design Considerations.

4. Books and Materials

Text Books:

1. Kramer, S. L, Geotechnical Earthquake Engineering, Pearson Education India, 1st Edition, 2003

Reference Books:

1. Bruce, A. B., Freeman, W. H., Earthquakes, W.H.Freemans and Co. Ltd., New York, 2nd Edition, 2003
2. Shames, Introduction to solid mechanics, 3rd Edition, PHI publications, New Delhi, 2009

Course Structure

A8169 - Road Safety Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the concepts of road safety. This course inculcate decision making and behavioral skills necessary to survive in the road environment. This course deals with the causes and consequences of accidents. The students are introduced to roles and responsibilities in ensuring road safety. This course highlights the importance of road safety audit and management.

Course Pre/co-requisites

A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8169.1 Discuss factors influencing road safety and road accidentss.
A8169.2 Categorise various road accidents.
A8169.3 Develop accident prevention measures for a given location.
A8169.4 Evaluate safety of the different road scenarios.
A8169.5 Discuss various road safety management strategies.

3. Course Syllabus

Road Safety Introduction: Road accidents, global and Indian trends, causes, highway safety, human factors, vehicle factors, road user limitations, speed and its effect on road safety.

Accident Investigation: Accident reporting, crash data collection, crash statistics, black spot analysis, crash rate and mortality rate, critical factors, risk indicators, accident frequency and severity models, collision and condition diagrams, introduction to crash reconstruction.

Accident Prevention: Accident prevention strategies, traffic calming, measures, benefits of traffic calming, accident prevention measures for intersection, injury control, post-injury

management.

Road Safety Audit: Key elements of road safety audit, road safety audits and investigation, work zone safety audit, crash investigation and analysis, identification of hazardous locations, and case studies.

Road Safety Management: Safe system approach, crash vs. accident – Road safety improvement strategies - Elements of road safety plan, speed management, intersection safety, and safe vehicle design.

4. Books and Materials

Text Books:

1. Tiwari, G. and Mohan D., Transport Planning and Traffic Safety: Making Cities, Roads and Vehicles Safer, 1^{st} Edition, CRC Press, 2016
2. Leonard Evans, Traffic Safety, Science Serving Society of Bloomfield Hills, Michigan,1^{st} Edition, 2004
3. Shinar D., Traffic Safety and Human Behaviour, 2^{nd} Edition, Emerald Publishing, 2017

Reference Books:

1. Rune Elvik, Truls vaa, Alena Hoye, and Michael Sorensen, Handbook of Road Safety Measures, 2^{nd} Edition, Emerald Publishing Group, 2009
2. Traffic Safety Toolbox: A Primer on Traffic Safety, ITE, 2^{nd} Edition, 1999

Course Structure

A8170 - Irrigation Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is designed to provide the engineering graduates with technical expertise in Irrigation Engineering to address the complexities of real-life Irrigation problems. In this course, students will know the importance of irrigation systems, irrigation methods and understand about the soil-water relationship and water requirement of crops. This course will cover various components storage head works of reservoirs, dams. This course also provides comprehensive knowledge on diversion head works and canal and cross drainage works.

Course Pre/co-requisites

A8107 - Fluid Mechanics

A8119 - Water Resources Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8170.1 Apply irrigation methods according to soil water plant relations to Plan an Irrigation System.
A8170.2 Estimate evapotranspiration and irrigation Efficiencies for crop water management.
A8170.3 Identify types of Reservoirs and Dams suitable for irrigation.
A8170.4 Analyze different Diversion Head Works for irrigation.
A8170.5 Select Canal and Cross Drainage Works for supply of water to land or crops.

3. Course Syllabus

Introduction to Irrigation: Irrigation development in India, necessity, scope, benefits and ill effects of irrigation, types of irrigation systems, methods of irrigation, physical and chemical properties of soils, soil nutrients, classification of irrigable soils, suitability of soils for irrigation, quality of irrigation water, soil water plant relations in irrigation, measurement of soil moisture, field capacity, wilting point, available water , hydraulic conductivity, water movement through soils.

Water Requirement of Crops: Principal Indian crops- crop seasons in India, Gross command area, Colourable command area, Intensity of irrigation, Duty, Delta and Base period Interrelationships, Factors Affecting the Duty, Methods for estimating evapotranspiration of crops, Consumptive use, Irrigation requirements, Frequency of irrigation, Irrigation Efficiencies.

Reservoirs and Dams: Reservoirs - Types of reservoirs, selection of site for reservoir, zones of storage of a reservoir, reservoir yield, estimation of capacity of reservoir using mass curve- Reservoir Sedimentation, Life of Reservoir. Dams - Types of dams, factors affecting selection of type of dam, Factors influencing selection of site for dams. Gravity dams - Definition of various components of Gravity dam, forces acting, Causes of Failures and remedial measures, Elementary profile, sketch the practical profile, uplift pressure. Earth dams - locations suitable for Earth Dams, types of earth dams, saturation gradient and phreatic line, Causes of failure of earth dams and remedial measures. Spillway, types of spillways and their suitability.

Diversion Head Works: Types of Diversion head works, Weirs and barrages, Layout of diversion head work, components. Causes and failure of weirs and Barrages on permeable foundations, Silt ejectors and Silt excluders, Design principles of weirs on permeable foundations using Creep theories, Exit gradient, U/S and D/S Sheet piles, Launching Apron.

Canal and Cross Drainage Works: Canal Falls - types of falls and their location, Design principles of Notch Fall and Sarada type Fall. Canal regulation works, principles of design of cross and distributary head regulators, types of Canal escapes - types of canal modules, proportionality, sensitivity, setting and flexibility. Cross Drainage works- types, selection of suitable type, various types, and design considerations for cross drainage works.

4. Books and Materials

Text Books:

1. Garg S. K, Irrigation Engineering and Hydraulic structures, 29th Revised Edition, Khanna Publishers, 2014.
2. B.C. Punmia, Irrigation and Water Power Engineering, 17th Edition, Laxmi Publication, 2021.

Reference Books:

1. Dilip Kumar Majumdar, Irrigation Water Management, 2nd Edition Prentice-Hall of

India, 2014.
2. K. R. Arora, Irrigation Engineering, Reprint Edition, Standard Publishers, 2011.

Reference Books:

1. S. K. Garg, Irrigation and Hydraulic structures, 5th Edition, Khanna Publishers, 2012.
2. K. Subramanya, Engineering Hydrology, 4^{th} Edition, Tata Mc GrawHill Publishing Company Ltd., 2017.

Course Structure

A8171 - Finite Element Method

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course introduces an advanced numerical method to solve civil engineering problems using finite element method. It starts with the introduction of plane stress – plane strain constitutive relationships along with the matrix algebra and discretization. The course covers formulating stiffness matrices and load vectors for one-dimensional and two-dimensional systems of various elements. It also gives insights on shape functions, generalized coordinate system and convergent requirements of different elements including axi-symmetric analysis.

Course Pre/co-requisites

A8115 - Structural Analysis

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8171.1 Illustrate concepts of FEM for solving civil engineering problems.
A8171.2 Develop the stress-strain and strain-displacement relations.
A8171.3 Formulate shape functions and stiffness matrices for 1D and 2D elements.
A8171.4 Solve two-dimensional problems using iso-parametric elements.
A8171.5 Evaluate different solution techniques for static loading conditions.

3. Course Syllabus

Introduction to Finite Element Method: Basic Equations in Elasticity Stress – Strain equation – concept of plane stress – plane strain advantages and disadvantages of FEM. Element shapes – nodes – nodal degree of freedom Displacement function – Natural Coordinates – strain displacement relations. Lagrangian – Serendipity elements – Hermite polynomials – regular, Irregular 2 D & 3D – Element – shape functions up to quadratic formulation.

Finite Element Analysis (FEA): one dimensional problem – Bar element – Shape functions stiffness matrix – stress – strain relation.

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

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

Solution Techniques: Numerical Integration, Static condensation, assembly of elements and solution techniques for static loads, Introduction to software (freeware).

4. Books and Materials

Text Books:

1. J.N. Reddy, Introduction to Finite element Method, McGraw Hill Education, 3rd Edition, 2005
2. S.Md. Jalaluddin, Finite element Methods, Revised and Enlarged Edition, Anuradha Pubilications, 2nd Edition, 2016

Reference Books:

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite element Method, Pearson, 3rd Edition, 2002
2. S.S. Bhavikatti, Finite Element Analysis, New Age International Publishers, 3rd Edition, 2015

Course Structure

A8172 - Designing with Geosynthetics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course will deal with the geosynthetics as construction materials in civil engineering projects. It will introduce the concept of geosynthetics, their manufacture, their behavior, and their applications in different civil engineering projects. Describes the design of Unreinforced and reinforced unpaved roads and pavements. Outlines the design and construction procedure for reinforced retaining walls. Helps in estimating the Bearing capacity of Reinforced soil systems and applying different geosynthetics as liners.

Course Pre/co-requisites

A8120 - Geotechnical Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8172.1 Categorize the geosynthetics based on their functions.
A8172.2 Compare the properties of geosynthetics.
A8172.3 Design the Pavement using Geosynthetic materials.
A8172.4 Construct a Reinforced Retaining wall using Geosynthetic materials.
A8172.5 Evaluate the Bearing capacity of the Reinforced Soil system and the influence of geosynthetics on liners.

3. Course Syllabus

Introduction to Geosynthetics: Historical background of Geosynthetics- Geosynthetics classifications-functions-applications- Polymers for Geosynthetics- Manufacturing Techniques.

Properties and testing methods: Various properties of Geosynthetics- physical properties-mechanical properties- hydraulic properties - endurance properties.

Geosynthetics in the pavement: Functions of Geosynthetics in the pavement, design of unpaved road, Giroud and Noiray method, Modified California Bearing Ratio (CBR) tests,

Design of pavement in unreinforced and reinforced conditions.

Geosynthetics in Retaining walls: Different types of facing elements, construction procedure, design of Reinforced Soil Wall, Introduction to geogrid reinforced soil walls and geocell wall.

Geosynthetics in bearing capacity and landfills: Bearing capacity of Geosynthetics reinforced soil system, Application of geosynthetics in soft clay and landfill liner.

4. Books and Materials

Text Books:

1. Koerner, R. M. (2012). Designing with Geosynthetics, 6th Edition, Vol. 1 and 2, Xlibris Corp.
2. Venkatappa, R. G. and Suryanarayana, R. G. V. S., Eds. (1990). Engineering with Geosynthetics, Tata McGraw Hill, New Delhi.

Reference Books:

1. Das B. M. (2019), Advanced Soil Mechanics, 5th Edition, Taylor and Francis Group, London.
2. Hausmann, M. R. (1990). Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York.
3. Giroud, J. P. (1984). Geotextiles and Geomembranes, Definitions, Properties and Design, Selected Papers, Revisions and Comments, 4th ed., IFAI Publishers.

Course Structure

A8173 - Urban Transportation Systems Planning

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces concepts involved in urban transportation planning. This course deals with key principles governing transportation planning, investment, operations and maintenance. It introduces the macroeconomic concepts central to transportation systems. This course deals with various evaluation studies in transportation planning. Students are introduced to various concepts involved in modal split analysis.

Course Pre/co-requisites

A8121 - Transportation Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8173.1 Explain urbanization, travel demand and planning strategies.
A8173.2 Compare different data collection techniques.
A8173.3 Develop trip generation and distribution models.
A8173.4 Model road user mode choice behavior and route section.
A8173.5 Evaluate various transport plans.

3. Course Syllabus

Urban Transport Planning: Urban Issues, Travel Characteristics, Evolution of Planning Process, Supply and Demand – Systems approach, Travel Demand - Trends, Overall Planning process, Demand Function, Independent Variables, Travel Attributes, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

Data Collection and Analysis: Collection of data – Organization of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Sampling Techniques, Expansion Factors, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

Trip Generation and Distribution: TSP Approach, Trip Generation Analysis: Zonal

Models, Category Analysis, Household Models, Trip Attraction models - Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models.

Modal **Split and Assignment:** Mode Choice Analysis: Mode Choice behavior, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches - Traffic Assignment: Basic Elements of Transport Networks, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Equilibrium Assignment, Diversion Curves.

Evaluation of Transport Proposals: Benefit-Cost Analysis, Goals Achievement Matrix and Planning - Evaluation Studies in Transportation Planning - Evaluation, Accessibility, and Environment – Economic Evaluation of Transportation Proposals.

4. Books and Materials

Text Books:

1. Bruton, M. J., An Introduction to Transportation Planning, Routledge, New York, 3rd Edition, 2021
2. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Pearson Education India, 3rd Edition, 2015

Reference Books:

1. Edwards, J. D., Transportation Planning Handbook, Institution of Transportation Engineers, Washington DC, 2nd Edition, 1999
2. Mayer M. and Miller E., Urban Transportation Planning: A Decision-Oriented Approach, McGraw Hill, 2nd Edition, 2001
3. Hutchinson, B.G., Principles of Urban Transportation System Planning, McGraw Hill, 1st Edition, 1974

Course Structure

A8174 - Solid and Hazardous Waste Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides engineering graduates with technical expertise in Solid Waste Management systems. This course will enable students to have a career and professional accomplishment in the public or private sector to address the complexities of real-life environmental engineering problems related to Solid Waste and Hazardous Waste. In this course, students will get a comprehensive understanding of Solid Waste fundamental concepts, Engineering Systems for Solid Waste Management, Engineering Systems for Resource and Energy Recovery, Engineering Disposal of Solid Waste and Hazardous Waste Management.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

A8127 - Environmental Engineering

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8174.1 Identify sources, types and composition of solid wastes.
A8174.2 Select suitable Engineering Systems for Solid Waste Management.
A8174.3 Analyze suitable Engineering Systems for Resource and Energy Recovery from solid waste.
A8174.4 Apply Engineering Systems for safe disposal of Solid Waste.
A8174.5 Utilize knowledge on Hazardous waste, E-waste, plastic waste, and Biomedical waste management to safeguard environment.

3. Course Syllabus

Solid Waste: Definitions, Types of solid waste, sources of solid waste, Characteristics, properties of solid waste, sampling of solid wastes, elements of solid waste management - Integrated solid wastes management, Solid Waste Management Rules 2016.

Engineering Systems for Solid Waste Management: Solid waste generation, on-site handling, storage and processing, collection of solid wastes, Stationary container system and Hauled container systems, Route planning, transfer and transport, processing and ultimate

disposal.

Engineering Systems for Resource and Energy Recovery: Solid Waste Processing techniques - biological and chemical conversion technologies, composting and its methods and challenges, vermicomposting, mechanical composting, in-vessel composting, incineration, pyrolysis, gasification, materials-recovery systems, recovery of biological conversion products, recovery of thermal conversion products, recovery of energy from conversion products, materials and energy recovery systems.

Engineering Disposal of Solid Waste: Dumping of solid waste, sanitary landfills – types, site selection, design, types of lining, operation, and challenges of sanitary landfills - Leachate collection and treatment, Leachate pollution and control, Monitoring landfills and Landfills reclamation. Energy recovery and biogas extraction from landfills.

Hazardous Waste Management: Sources and characteristics of hazardous waste, effects on environment, risk assessment, disposal of hazardous wastes, secured landfills, incineration, and Monitoring. Biomedical waste disposal, E-waste management, Plastic waste management, Nuclear Wastes, Industrial waste Management. Hazardous waste, E-waste and Biomedical waste Management Rules 2016.

4. Books and Materials

Text Books:

1. Rao, M.N., Sultana, R., Kota, S. H., Solid and Hazardous Waste Management: Science and Engineering, Elsevier, Butterworth-Heinemann, 1st Edition, 2016.
2. Tchobanoglous G, Theisen H, Vigil S.A., Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, 2nd Edition, 2014

Reference Books:

1. Vesilind, P.A., and Worrell W. A. , Solid Waste Engineering, Cengage India, 2nd Edition, 2016
2. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G. (2017). Environmental Engineering, McGraw Hill Education, 1st Edition, 2017
3. CPHEEO Manual on Municipal Solid Waste Management, Ministry of Urban Development, India, 1st Edition, 2016

Open Electives

Course Structure

A8181 - Smart Cities

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The purpose of this course is to provide a deep understanding about smart and sustainable cities. The course will begin with the basic concepts and theories of urbanization and elements. The course will cover the global practices in the smart cities and technologies in shaping new and existing cities. The course will include the feasibility for smart cities and financing approaches for urban development. The course will also include the role of electric vehicles and energy rating system for smart cities.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8181.1 Interpret the concepts, history and evolution of smart cities.
A8181.2 Identify the elements of smart city such as smart people, smart living, smart economy, smart infrastructure, smart governance and smart environment.
A8181.3 Analyze the concepts, discourses and practices of smart cities across globe.
A8181.4 Develop the road map for planning smart cities and benchmarking their performance for Indian context.
A8181.5 Apply relevance for smart cities of developing economies considering issues as inclusiveness, feasibility and sustainability.

3. Course Syllabus

Introduction to Smart and Sustainable Cities: Concepts and theories of Urbanization, City Planning, Emergence of Sustainability, Liveability, Green to Smart Cities; Understanding smart cities – Concepts, History and Evolution of Smart Cities.

Dimensions of Smart Cities: Elements of Smart City – Smart People, Smart Living, Smart Economy, Smart Infrastructure, Smart Governance, Smart Environment.

Global Experience of Smart Cities: Case studies from European, Middle East and Asian Contexts, specifically cases of Barcelona, Amsterdam, Majhdhar, and Singapore, Review of Global Standards.

Smart City Planning and Development: How to plan for smart cities, Concepts of Retrofitting, Redevelopment, Extension and Pan city approaches, Review of Smart financing approaches, Tools, concepts of special purpose vehicles, Land pooling-based financing approaches of urban development.

Sustainable Development in Smart Cities: Energy storage and utilization, role of electric vehicles, autonomous vehicles in urban mobility, Green Audit, Energy saving system.

4. Books and Materials

Text Books:

1. M.Barlow and C. Levy-Bencheton. Smart Cities, Smart Future: Showcasing Tomorrow
2. Gassmann, J.Böhm Smart Cities: Introducing Digital Innovation to Cities

Reference Books:

1. UN-Habitat; Inclusive and sustainable urban planning: a guide for municipalities; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4)
2. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science
3. Draft Concept Note on Smart City Scheme. Government of India - Ministry of Urban Development.

Course Structure

A8182 - Disaster Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course has been framed with an intention to provide a general concept in the dimensions of disasters caused by nature beyond human control as well as the disasters and environmental hazards induced by human activities with emphasis on Natural disaster, Man-made disaster, vulnerability and risks of disasters, Disaster Management Mechanism, Capacity Building and disaster coping Strategies and Disaster management planning.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8182.1 Identify basic concepts of hazards, vulnerabilities and risks of disaster phenomena.
A8182.2 Interpret various types of disasters and disaster coping strategies.
A8182.3 Examine Disaster Impacts and suggest suitable capacity building frame work for disaster management.
A8182.4 Select appropriate steps in Disaster management cycle for Disaster Risk Reduction.
A8182.5 Develop Strategies for disaster management planning and sustainable development.

3. Course Syllabus

Introduction: Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation, disaster phenomena, events global National & Regional.

Disasters: Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile

of India, Covid 2019 in India, mountain and coastal areas, ecological fragility, coping with disaster- strategies, safety norms & survival kits.

Disaster Impacts: Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters, capacity building – concepts, assessment –structural & non-structural measures, legislative support.

Disaster Risk Reduction: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Disasters, Environment and Development: Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environment friendly recovery; reconstruction and development methods.

4. Books and Materials

Text Books:

1. Manual on Disaster Management, National Disaster Management Authority, Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2017.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India.

Reference Books:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.

Course Structure

A8183 - Environmental Pollution Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course has been designed to improve the understanding of the students about different pollution control strategies and the skills of application of remediation techniques to combat pollution in three environmental compartments i.e., air, water and soil. The course will also be dealing about the sources of pollution in air, soil, water, and noise and the impacts these sources on the environment and health. In addition, the students will be given the knowledge to develop the particular skills required in pollution related structured research and environmental management.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8183.1 Identify water pollution sources, types and treatment methods.
A8183.2 Apply knowledge on Prevention and control of air pollution.
A8183.3 Inspect sources, effects and mitigation methods of noise pollution.
A8183.4 Examine soil pollution sources, effects and control measures.
A8183.5 Develop Environmental management plan to minimize environmental pollution.

3. Course Syllabus

Water pollution: Water Pollution - Introduction - Sources and types of water pollutants Physical, Chemical and Biological. Ground water - Surface water - lake water - seawater. Effects of water pollution. Water Quality standards (Drinking and Industrial) - water treatment - physical, chemical and biological. Water Pollution Prevention and Control Act, 1974.

Air pollution: Structure and composition of atmosphere – classification, sources and effects of air pollution – Acid rain – greenhouse effect – global warming – Ozone depletion, Prevention and control of air pollution particulate control – settling chamber, scrubber, bag filter, cyclones electrostatic precipitators. Gaseous emission control methods. Air pollution

prevention and control Act 1981.

Noise Pollution: Noise Pollution Basics of acoustics- propagation of indoor and outdoor sound- noise profiling effects of noise – measurement, index and mitigation methods- health effects of noise- Vibration and its Effects, Whole body vibration problems in opencast mines-ground vibration and Air blast. Green Belt Development–Principles and design considerations, Industrial Noise Pollution Control methods.

Soil Pollution: Sources - solid waste disposal and their effects - pesticides - types and effect of pollutants on Plants - animals and human beings - biomagnification - fertilizers and its Effect of pollutants on plants - animals and human beings - soil pollution Control measures - soil microbes and function - biofertilizer.

Environmental management: Environmental impact assessment and statement; Government strategies in pollution control: subsides, polluter pays principle and regulations; Government Agencies and Programs – The Tiwari committee – creation of NCEPC, Department of Environment & Forest – Function of State Pollution Control Board. Sources of environmental information and regulations; Sustainable development and environmental protection.

4. Books and Materials

Text Books:

1. C. S. Rao, Environmental Pollution Control Engineering, 3^{rd} Edition, New Age International Pvt Ltd, 2018.
2. Rao, M. N and H.V.N. Rao, Air Pollution, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2017.
3. Kudesia, V.P and Ritu Kudesia, Water Pollution, Pragati Prakashan Publication, Meerut, 2017.
4. Murphy, E., King,E., Environmental Noise Pollution, 1^{st} Edition , Amsterdam : Elsevier, 2014.

Reference Books:

1. H.S Peavy, D. R. Rowe, G. Tchobanoglous, Environmental Engineering, Indian Edition, McGraw Hill Education (India) Pvt Ltd, 2014.
2. De Nevers, N., Air Pollution Control Engineering, 3^{rd} edition, Waveland Press Inc 2017.
3. Sagar Pal Singal, Noise Pollution and Control Strategy, 2^{nd} Edition, Alpha Science International Ltd, 2005.

Course Structure

A8155 - Green Building and Sustainability

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces concepts of sustainability in the context of construction building materials. It also discusses the role of low carbon cements and recycled aggregate in minimizing consumption of natural resources. The course also emphasizes the concepts of embodied, operational, life cycle energy and minimizing energy consumption. It also intends to make students aware of rating systems like LEED, GRIHA etc.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8155.1 Identify green building and green building materials.
A8155.2 Make use of different rating agencies to classify the type of building.
A8155.3 Analyze sustainability and its implications for the practice of engineering.
A8155.4 Evaluate the potential of the alternative construction materials for sustainability.
A8155.5 Examine the green building rating systems and its contribution to sustainability.

3. Course Syllabus

Green Building: Concept of Green building, Principles of green buildings, Eco-friendly materials, Certification systems – Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED).

Green Building Materials: Green Building Materials and Equipment in India, what are key requisites for Constructing a Green Building, Important Sustainable features for Green Building. **Building Services:** Fire protection – classes of fire and causes, development of fire, fire resisting materials, means of escape, Standing Fire Advisory Council norms. Water supply -Water distribution and plumbing fixtures.

Applications in the Built Environment: Concepts of green buildings, climate responsive building - Reduction of energy consumption, direct and indirect methods - Reduction of water consumption, direct and indirect methods - Carbon footprint and eco footprints of buildings - New concepts and trends in green buildings, national and international.

Sustainability: The Concept of Sustainability; Definition of Sustainability, Dimension of Sustainability. Three Pillars of Sustainability, Principles of Sustainability - 5R, Construction Materials Resource Efficiency, Operational Reuses of the Construction Materials, Sustainability Goals for construction Industry.

Sustainability in Built Environment: Environmentally sensitive design, low impact development, green infrastructure and conservation design, Green buildings and land use planning, Energy use and buildings.

4. Books and Materials

Text Books:

1. Frederick S. Merritt, Jonathan T. Ricketts, Building design and construction Handbook, McGraw-Hill Inc., 5th edition,1994.
2. Fred hall and Roger Greeno, Building Services Handbook, Routledge, 7th edition, 2013.
3. Bradley A. Striebig, Adebayo A. Ogundipe and Maria Papadakis, Engineering Applications in Sustainable Design and Development, 1st edition, 2016.

Reference Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

Course Structure

A8224 - Electric Vehicles

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamental concepts, principles, architectures and analysis of electric vehicles. Student will explore the working principle of electric vehicles, delve into key roles played by motors as propulsion systems and requirements for battery and its management systems. In addition to this, focuses on various charging systems and charging infrastructure. This course also emphasizes the EV business and the future trends in the development of electric vehicles.

Course Pre/co-requisites

A8213-Electrical Machines-II

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8224.1. Infer the electric vehicle system and its impact on environment.
A8224.2. Analyze the various hybrid vehicle configurations and its performance.
A8224.3. Interpret the electric drives used in hybrid and electric vehicles.
A8224.4. Choose proper energy storage systems for electric vehicle applications.
A8224.5. Identify the different charging systems and charging infrastructure for EVs.

3. Course Syllabus

Introduction To Electric Vehicles: EV System: EV Configuration-Fixed & variable gearing, single & multiple motor drive, In-wheel drives. Components of an EV, Components of ICEVs, EV History, the early years, recent EVs and HEVs, Types of EVs, EV Advantages, Comparison of EVs and ICEVs w.r.t to efficiency, pollution, capital & operating cost.

Hybrid Electric Vehicles: Types of Hybrids Vehicles- Series, parallel, series-parallel and complex HEVs, Advantages and Disadvantages of HEVs, Concept of Hybrid Electric Drive Trains, Architectures and power flow control of Hybrid Electric Drive Trains.

Electric Propulsion Systems: Choice of electric propulsion systems, block diagram of

EV propulsion system, BLDC Machine Construction and Classification, Basic Principles of BLDC Motor Drives, application to Electric Vehicles. Switched Reluctance Motor Drives, Basic Magnetic Structure, Torque Production, SRM Drive Converter, Modes of Operation, Generating Mode of Operation.

Introduction To Energy Storage Requirements: Electrochemistry of battery cells, Battery parameters, Types of Batteries- Lead–Acid Batteries, Ni Cd Batteries, NiMH Batteries and Lithium-Ion Batteries. EV Charging: Types of charging systems- Conductive charging On board & off-board charging, inductive charging, Wireless charging.

Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and charge zone. Key Battery Management Technologies, Typical Structure of Battery Management Systems. Business: E-mobility business, electrification challenges, Connected Mobility and Autonomous Mobility- case study, E-mobility Indian Roadmap, social dimensions of EVs.

4. Books and Materials

Text Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
2. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES: Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., 2003
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wi- ley and Sons, 2012.

Reference Books:

1. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wi- ley and Sons, 2012.
2. Reissland, Martin.U (2010), Electrical Measurements: Fundamentals, Concepts, Applications, New Age International (P) Limited, New Delhi.
3. Shen, Weixiang Xiong, Rui, "Advanced battery management technologies for electric vehicles" 2019, John Wiley & Sons

Course Structure

A8281 - Solar Energy and Applications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students about the solar energy technologies and potentials. The course aims to introduce the concepts of Photo Voltaic cells, their properties, and its societal needs. The applications of solar cells will be explained in detail also the environmental issues of solar systems will be explained. It also covers the economic analysis of a solar energy system and its environmental benefits.

Course Pre/co-requisites

"The course has no specific prerequisite and co-requisites"

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8281.1. Compare the present and future available electrical power from solar energy based on the knowledge of global solar horizontal irradiation.

A8281.2. Assimilate and acquire the skills for design and engineering of solar thermal and solar photovoltaic technology and systems.

A8281.3. Identify the problems involved in solar thermal energy conversion technique used in the solar heating and cooling systems for buildings/societal needs.

A8281.4. Examine the components of a solar photo voltaic system and their function by utilizing the previous literature knowledge on different photovoltaic solar cells.

A8281.5. Analyze the techno-economics performance and issues in the solar energy system.

3. Course Syllabus

Theory

Principles of Solar Radiation: Role and potential of solar energy, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and Sun shine, solar radiation data.

Solar Energy Collectors: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Different methods of solar energy storage, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating /cooling technique, solar distillation and drying.

Photo Voltaics (PV): Fundamentals of solar cells, types of solar cells, absorption of photons, excitations and photo emission of electrons.
PV Cell Properties: Solar cell properties and design, p-n junction photodiodes, depletion region, electrostatic field across the depletion layer, electron and holes transports, device physics, charge carrier generation, recombination and other losses, I-V characteristics, output power.

Solar Cell Applications:PV cell interconnection, module structure and module fabrication, Equivalent circuits, load matching, efficiency, fill factor and optimization for maximum power, Design of stand-alone PV systems, system sizing, device structures, device construction, DC to AC conversion, inverters.

Cost Analysis and Environmental Issues: Cost analysis and pay back calculations for different types of solar panels and collectors, installation and operating costs, Environmental and safety issues, protection systems, performance monitoring.

4. Books and Materials

Text Books:

1. G. D. Rai (2009), Non-Conventional Energy Sources, 4^{th} Edition, Khanna Publishers, New Delhi.
2. Martin A. Green (2008), Solar Cells: Operating Principles, Technology and system Applications, 1^{st} Edition, Prentice Hall, New Delhi.

Reference Books:

1. B. H. Khan (2016)- Non Conventional Energy Resources-3^{rd} Edition, McGraw Hill Education (India) Private Limited.
2. Sukatme (2008), Solar Energy, 3^{rd} Edition, McGraw Hill Companies, New Delhi.
3. D. Yogi gosuami, Frank Kreith, Jan F. Kreider (2000), Principles of Solar Engineering, 3^{rd} Edition, Taylor & Francis, USA.

Course Structure

A8282 - Energy Storage Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students to impart fundamental knowledge on energy storage systems considering the operation and design of various energy storage devices. This course provides a foundation for understanding the general principles and fundamentals of lithium-ion rechargeable battery engineering, fuel cells and super capacitors.

Course Pre/co-requisites

"The course has no specific prerequisite and co-requisites"

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8282.1. Apply the knowledge of concepts of science to understand the concepts of electro chemical cell.

A8282.2. Apply the knowledge of electro chemistry to describe the components and process in batteries.

A8282.3. Describe the electrical, thermal, and mechanical behavior of Li-Ion batteries under various operating conditions.

A8282.4. Apply the knowledge of basic science concepts to distinguish various types of fuel cells and their functionalities

A8282.5. Apply the knowledge of science to interpret the operation and characteristics of super capacitors.

3. Course Syllabus

Theory

Battery Technology Overview: Battery definitions, terms and terminology, Primary cells, Secondary cells. Electro chemistry - Electro chemical energy sources, Voltage and potential energy, Reduction and oxidation, Reduction potentials and electro chemical couples.

Battery Construction : Electro chemical cell, Cell mechanical structure, Resistance and polarization, Electrode design, Discharging and charging. Major Battery Chemistries and performance comparison.

Lithium-Ion Batteries: Lithium-ion cell reaction, construction - pouch cells, cylindrical, flexible foil. Principle of operation, Charge and discharge characteristics, State of charge (SOC), State of health (SOH), State of function (SOF), Charging procedures, Safety of

lithium-ion batteries, Lifetime. Types of Lithium-ion Batteries .

Fuel Cells: Introduction – working, performance characteristics and efficiency, types of fuel cell – Alkaline Fuel Cell, Polymer Electrolyte Membrane Fuel Cell, Molten Carbonate Fuel Cell, Solid-Oxide Fuel Cell, hydrogen fuel cells.

Super Capacitors: Introduction, Electro chemical Double-Layer Super capacitors, Charge-Discharge characteristics, Energy and power density, Design Considerations, Stacking and Voltage cell balancing.

4. Books and Materials

Text Books:

1. John Warner, The Handbook of Lithium-Ion Battery Pack Design: Chemistry, Components, Types and Terminology, 1^{st} Edition, Elsevier Science, 2015.
2. 2. Reiner Korthauer, Lithium-Ion Batteries: Basics and Applications, 1^{st} Edition, Springer, 2018.

Reference Books:

1. R. O'hayre, S.W. Cha, W.G. Colella, F.B. Prinz, Fuel Cell Fundamentals, 3^{rd} Edition, Wiley, 2016.
2. Masaki Yoshio, Ralph J. Brodd, Akiya Kozawa, Lithium-Ion Batteries: Science and Technologies, 1^{st} Edition, Springer, 2009.
3. Aiping Yu, Victor Chabot, Jiujun Zhang, Electrochemical Supercapacitors for Energy Storage and Delivery: Fundamentals and Applications, CRC Press, 2013.

Course Structure

A8283 - Power Generation Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Electrical Energy plays a significant role in day-to-day life of entire mankind. This course deals with the generation of power along with its economic aspects. It deals with the basic theory of various conventional power stations and the different components present in them. The course also helps the students to familiarize with different types of substations and its advantages and disadvantages. It also deals with the economic aspects of power system, power factor correction techniques and suitable pricing methods.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8283.1 List the different components of an electric power system.
A8283.2 Categorize the conventional methods of generating electrical power to meet the required load demand.
A8283.3 Categorize the Non-conventional methods of generating electrical power to meet the required load demand.
A8283.4 Model a power system to reduce economic losses.

3. Course Syllabus

Introduction: Conventional Energy Sources and their availability, Non-Conventional Energy Sources and their availability, Environmental impact of conventional and Non-Conventional energy sources.Hydro Electric Power Plants: Site selection, Plant layout, various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydroelectric plants (mini and micro).

Thermal Power Plant: Site selection, Plant layout, Coal its storage, Preparation, Handling, Feeding and burning, Cooling towers, Ash handling, Water treatment plant, High pressure boilers and steam turbines.

Nuclear Power Plant: Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect.

Non-Conventional Energy: Types of Non conventional Energy generation: solar, wind, tidal, biomass and wave energy.

Economic Aspects of Power Generation and Tariff Methods: Base load and peak load on power station. Interconnected grid system, Load curve, load duration and integrated load duration curves, demand, diversity, capacity, utilization and plant use factors. Costs of electrical energy - Fixed, Semi-fixed and Running Costs, Selection of type of generation and generation equipment, Performance and operating characteristics of power plants, Economic scheduling principle. Tariff, Characteristics, Types - Flat Rate, Block-Rate, two-part, three-part, and power factor tariff methods.

4. Text Books:

1. M. L. Soni, P. V. Gupta, U. S. Bhatnagar, A. Chakrabarti (2010), "A Text Book on Power System Engineering", 2nd Edition, Dhanpat Rai & Co. Pvt. Ltd, New Delhi.
2. C. L. Wadhwa (2010), "Generation, Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International (P) Limited, New Delhi.

Reference Books:

1. Leonard L. Grigsby (2012), "Electric Power Generation Transmission and Distribution, 3rd Edition, CRC press.
2. J. B. Gupta (2010), "A Course in Power Systems", 10th Edition, S. K. Kataria & Sons, New Delhi.

Course Structure
A8381 - Hybrid Vehicles

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The Basics of Hybrid Vehicles course introduces fundamental concepts in hybrid technology, combining internal combustion engines with electric propulsion. Students learn about hybrid vehicle architectures, regenerative braking, and battery systems. The curriculum covers energy management strategies, efficiency considerations, and the environmental impact of hybrid vehicles. Practical insights and case studies provide a foundation for understanding the design and operation of hybrid transportation systems.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8381.1 Identify different types of hybrid vehicles and their power train configurations
A8381.2 Analyze the energy management strategy for hybrid vehicles
A8381.3 Develop and optimize the hybrid vehicles subsystems
A8381.4 Apply advanced technologies and materials in hybrid vehicles design
A8381.5 Evaluate the performance and environmental impact of hybrid vehicle.

3. Course Syllabus

Introduction to Hybrid Vehicles:

Overview of hybrid vehicles and their advantages, types of hybrid vehicles (series, parallel, series-parallel), comparison with conventional vehicles and electric vehicles, historical background and evolution of hybrid vehicles, current market trends and future prospects.

Powertrain and Energy Storage Systems: Overview of powertrain configurations for hybrid vehicles, electric motors and their control systems, internal combustion engines and their optimization for hybrid use, energy storage systems (batteries, capacitors, flywheels) and their selection criteria, power electronics and electrical systems for energy conversion and distribution.

Energy Management and Control Systems: Overview of energy management strategies for hybrid vehicles, energy flow diagrams and efficiency maps, control systems for hybrid powertrains (electronic controls, sensors, actuators), algorithm development for optimal energy management, real-time operating systems and software architectures for vehicle control.

Aerodynamics and Thermal Management: Overview of aerodynamic principles relevant to hybrid vehicles, drag reduction techniques and wind tunnel testing, cooling system design and optimization for hybrid vehicles, climate control systems and cabin comfort considerations, NVH (noise, vibration, harshness) management in hybrid vehicles.

Challenges and Opportunities in Hybrid Vehicle Design: Discussion of challenges unique to hybrid vehicle design (e.g., packaging, weight, cost), opportunities for innovation and advancement in hybrid technology, case studies of successful hybrid vehicle designs and their lessons learned, future outlook for hybrid vehicles and their role in sustainable transportation, emerging trends in alternative propulsion technologies (fuel cells, hydrogen fuel cell vehicles, autonomous vehicles)

4. Books and Materials

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management

Reference Books:

1. . M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge.

Course Structure

A8382 - Fundamentals of Robotics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students to the basics, types and elements of robots. The course exposes students to the theoretical concepts of robot kinematics. Path planning and trajectory planning concepts gives the perception on control of robotics. The concepts on actuators and sensors gives clear understanding and design ability for mobility systems. It gives an overview on application of robotics in manufacturing industry.

Course Pre/co-requisites

A8002 - Ordinary Differential Equations and Vector Calculus

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8382.1 Illustrate the basic concepts and components of a robotic system
A8382.2 Select appropriate actuators and sensors for designing robot mobility system
A8382.3 Solve transformation problems to describe the robot position and orientation of robot
A8382.4 Apply the concepts of robot work cell design and control
A8382.5 Choose appropriate robots for various applications suitable to modern manufacturing systems.

3. Course Syllabus

Introduction to Robotics: Classification of Robots, Advantages and Disadvantages of Robots, Degree of freedom, joints, Robot coordinates, Robot workspace, Robot characteristics, Robot Components, types of robot arms, end effectors, grippers.

Actuators: Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic and Pneumatic Devices, Electric Motors in Robotics.Sensors: Sensor Characteristics, Position Sensors, Velocity Sensors, Acceleration Sensors, Touch and Tactile Sensors, Proximity Sensors, Range Finder.

Manipulator Kinematics: Specifications of matrices, Homogeneous Transformation, D-H notation, joint coordinates and world coordinates, Forward and inverse kinematics, Simple problems.Path Planning:Trajectory planning and avoidance of obstacles, Path planning, introduction to robot programming.

Robot Work Cell Design and Control: Robot Cell Layouts, Multiple Robots and Machine Interface, Some Consideration in Work Cell Design, Interlocks, Error Detection and Recovery, Robot Cycle Time Analysis.

Robotic Applications: Robots in manufacturing and non- manufacturing applications, Health Service, Intelligent Home Applications, Military Applications, Space Application, Entertainment robots, Service robots, Domestic or household robots.

4. Books and Materials

Text Books:

1. Richard D. Klafter, Robotic Engineering, 2nd Edition, Prentice Hall of India, New Delhi.
2. M.P. Groover, Industrial Robotics, 3rd Edition, Pearson Education, New Delhi.

Reference Books:

1. R.K. Mittal, I.J. Nagrath, Robotics and Control, 1st Edition, Tata Mc Graw Hill, New Delhi.
2. P. Coiffet, M. Chaironze, An Introduction to Robot Technology, 3rd Edition, Kogam Page Ltd,London.
3. Ganesh S. Hegde, A Textbook of Industrial Robotics, 2nd Edition, University Science Press.

Course Structure

A8383 - 3D Printing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

3D printing is an additive manufacturing process whereby objects are built up from plastic filament, liquid resin, layers of powder, or even bio-compatible and edible materials.Desktop 3D printing is today's printing press, putting rapid prototyping, customizable products, and individualized medical appliances in reach of the general public. Literacy in basic 3D modeling and manufacturing is an essential skill for future STEM success in this country. In this course students will learn how to be "makers" by using various types of 3D modeling software and imaging equipment, printing actual physical objects that they have designed and modeled themselves, and participating in educational outreach in the institute and the community.

Course Pre/co-requisites

A8302 - Computer Aided Drawing

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8383.1 llustrate the fundamental concepts of Additive Manufacturing and 3-D printing, its advantages and limitations
A8383.2 Apply engineering knowledge, techniques, skills and modern tools to analyze problems in 3D Printing
A8383.3 Appraise additive manufacturing through 3d printing
A8383.4 Solve Complex manufacturing problems for significant technological and societal development
A8383.5 Evaluate engineering products using the knowledge of mathematics, science, engineering and IT tools.

3. Course Syllabus

Introduction to 3D Printing: Fundamental of 3D printing, Need for 3D printing Generic 3d printing process, Distinction between 3D printing and CNC, Classification of 3D printing Processes, Steps in 3D printing process, Advantages of 3D printing, standards for 3D printing, Major Applications. VAT Photo Polymerization 3d Printing Processes: Stereo

lithography (SL), Materials, SL resin curing process, Process Benefits and Drawbacks, Applications of Photo polymerization Processes.

Material and Binder Jetting 3D Printing Processes: Evolution of Printing as a 3D printing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes. Binder Jetting 3d Printing Processes: Materials, Process Benefits and Drawbacks, Research achievements in printing deposition, Technical challenges in printing, Applications of Binder Jetting Processes.

Extrusion-Based 3D Printing Processes: Fused Deposition Modeling (FDM), Principles, Materials, Plotting and path control, Bio-Extrusion, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes. Powder Bed Fusion 3d Printing Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Directed Energy Deposition 3D Printing Processes: Process Description, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. Wire arc based additive manufacturing methods, Advantages and disadvantages, comparison with conventional 3D printing and WAAM. Post Processing of 3d Printing Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. Inspection of 3D printing parts: Different destructive and non-Destructive testing of 3D printing parts, acceptance standards for 3D printing parts.

3D Printing Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.

4. Books and Materials

Text Books:

1. Ian Gibson, David W Rosen, Brent Stucker,Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Edition, Springer.
2. Ali K. Kamrani, EmandAbouel Nasr,Rapid Prototyping: Theory & Practice,2nd Edition, Springer.

Reference Books:

1. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling,1st Edition, Springer.
2. Rafiq Noorani,Rapid Prototyping: Principles and Applications in Manufacturing,1st Edition, John Wiley & Sons.

Course Structure

A8402 - Digital Electronics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims to teach students the fundamentals of digital electronics. Starting from learning the basic postulates of Boolean algebra, to cover map method for simplifying Boolean expressions, to outline the formal procedures for the analysis and design of combinational and sequential circuits, to design combinational and sequential programmable devices. These digital components are the basic building blocks from which more complex digital systems are constructed.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8402.1. Apply fundamental theorems and properties of Boolean algebra to simplify a Boolean function.
A8402.2. Apply the map method to obtain simplified and optimized logical expressions.
A8402.3. Build combinational circuits using logic gates for real time digital systems.
A8402.4. Analyze the behaviour of latches and flipflops for designing sequential logic. .
A8402.5. Make use of programmable logic devices in the design of digital systems.

3. Course Syllabus

Boolean Algebra and Logic Gates: Introduction, basic definitions, axiomatic definition of Boolean algebra, basic theorem and properties, Boolean functions, canonical and standard forms, digital logic gates.

Gate-Level Minimization: The map method, two-variable, three-variable and four-variable K-maps, sum-of-products, product-of-sums simplification, don't-care conditions, NAND and NOR implementation.

Combinational Logic: Combinational circuits, analysis procedure, design procedure, binary adder-subtractor, magnitude comparator, decoders, encoders, multiplexers, demulti-

plexers.

Synchronous Sequential Logic: Sequential circuits, storage elements – latches and flip-flops, analysis of clocked sequential circuits. **Registers and Counters:** Registers, shift registers, ripple counters, synchronous counters.

Memory and Programmable Logic: Random-Access Memory, read-only memory, programmable logic array, programmable array logic.

4. Books and Materials

Text Books:

1. M. Morris Mano, Michael D. Ciletti (2017), Digital Design With an introduction to the Verilog HDL, 6thEdition, Pearson Education/ PHI, India

Reference Books:

1. Ronald J Tocci, Ronald J Tocci, Neal S Widmer , Gregory L Moss , Digital Systems - Principles an Applications , 10th Edition, Pearson Education International
2. Charles H RothJr, Larry L Kinney, Fundamentals of Logic Design,6th Edition, Cengage Learning

Course Structure

A8481 - Basic Electronics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course covers fundamental topics that are common to a wide variety of analog and digital electronics. This course starts with basics of semiconductors, review the operation and characteristics of semiconductor devices (namely, semiconductor diodes and BJTs), and buildup to more advanced topics in analog circuit designs.

Course Pre/co-requisites

A8006 - Applied Physics.
A8204 - Basic Electrical Engineering.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8481.1 Analyze the operation and characteristics of electronic devices.
A8481.2 Construct electronic circuits making use of diodes and transistors.
A8481.3 Analyze single stage amplifiers using small signal low frequency transistor model.
A8481.4 Analyze the effect of negative and positive feedback on amplifiers.
A8481.5 Design single stage amplifier for given specifications.

3. Course Syllabus

Diode and its Characteristics: P-N junction diode, operation in forward and reverse bias conditions, V-I characteristics, Zener diode and its characteristics, rectifiers - half wave, full wave and bridge rectifiers (simple problems), Filters (qualitative treatment), voltage regulation using Zener diode.

Transistors: Bipolar Junction Transistor (BJT) - construction, operation, CE, CB and CC transistor configurations and characteristics. **BJT Biasing:** Need for biasing, operating point, load line analysis, biasing and stabilization techniques: fixed bias, collector to base bias, self-bias.

BJT Amplifiers: Transistor as an amplifier, BJT h-parameter model, analysis of transistor amplifier using h- parameter model, CE, CB and CC amplifiers, comparison of CB, CE and CC configurations, Simplified h parameter model.

Feedback Amplifiers Concept of feedback, classification of feedback amplifiers, general Characteristics of negative feedback amplifiers, effect of negative feedback on input and output resistances.

Oscillators: Condition for oscillations, RC Phase shift oscillator with transistor, Wein bridge oscillator, Hartley and Colpitts oscillator.

4. Books and Materials

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, PHI, 2013.
2. Jacob Milliman, Christos C .Halkias, Satyabrata Jit (2011), Electronic Devices and Circuits, 3rd edition, Tata McGraw Hill, New Delhi

Reference Books:

1. G.K.Mittal (1999), Electronic Devices and Circuits, 22nd edition, Khanna Publications, New Delhi
2. S. Shalivahanan, N. Suresh Kumar, A. Vallavaraj (2007), Electronic Devices and Circuits, 3rd edition, McGraw Hill, New Delhi, India.

Course Structure

A8482 - Principles of Communication Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides a foundation in the theoretical aspects of Electronic Communication Systems. This course focuses on Analog and Digital Communications, Pulse and Data Communications. This course forms the basis for the study of advanced communication systems like Telephone Switching networks, Computer Communications, Radar Communications, Cellular and Mobile Communications, Optical Communications and Satellite Communications.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8482.1 Summarize the fundamental concepts and acquire competencies for each topic of analog and digital modulation techniques.

A8482.2 Illustrate elements of analog, digital and data communications systems and identify their real-time applications.

A8482.3 Compare analog and digital communication systems with respect to performance parameters and applications.

A8482.4 Analyze the error control and coding techniques including Source Coding Technique, Huffman Source Coding, Error Control, and Coding.

A8482.5 Distinguish the features of advanced communication systems.

3. Course Syllabus

Introduction to Electronic Communications: Historical Perspective, Electromagnetic Frequency Spectrum, Signal and its Representation, Elements of Electronic Communications System, Primary Communication Resources, Signal Transmission Concepts, Analog and Digital Transmission, Modulation, Concept of Frequency Translation, Signal Radiation and Propagation, Classification and Sources of Noise, Signal-to-Noise Ratio (SNR), Noise Figure.

Principles of Analog Communication: Types of Analog Modulation, Principles of Amplitude Modulation, AM Power Distribution, Limitations of AM, DSBSC Modulation, SSB Modulation, Vestigial-Sideband Modulation, Comparison of Analog Modulations, Applications, Principles of Angle Modulation, Theory of FM—Basic Concepts, Spectrum Analysis, Narrowband and Wideband FM, Theory of Phase Modulation, Relationship between FM and PM, Comparisons and Applications of FM and PM.

Sampling Theorem and Pulse Modulation Techniques: Digital Versus Analog Transmissions, Sampling Theorem, Classification of Pulse-Modulation Techniques: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Pulse-Code Modulation (PCM), Quantization of Signals, Delta Modulation, Comparison of PCM Techniques, Vocoders.

Digital Modulation Techniques and Information Theory: Types of Digital Modulation, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Phase Shift Keying, M-Ary PSK, Quadrature Amplitude Modulation, Minimum Shift Keying, Information, Entropy and Its Properties, Channel Capacity Theorem, Objectives of Source Coding, Source Coding Technique, Huffman Source Coding, Error Control and Coding.

Advanced Communication Systems: Spread Spectrum Communication: General Model, Features, Multiple Access techniques, Telephone Switching, Computer Communications, Optical Communications, Mobile Communications-the Cellular Concept, Satellite Communications, RADAR systems.

4. Books and Materials

Text Books:

1. T L Singal, “Analog and Digital Communications”, 1st edition, Tata McGraw-Hill, 2012
2. H. Taub, D L Schilling and G Saha, “Principles of Communication Systems”, 3rd Edition, Tata McGraw-Hill, 2008.

Reference Books:

1. George Kennedy, Electronic Communication Systems, Tata McGraw-Hill.
2. B. P.Lathi, “Modern Analog and Digital Communication Systems”, 3rd Edition, Oxford University Press, 2007.

Course Structure

A8483 - Fundamentals of IoT

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces you to Advance concepts and design techniques for creating Internet of Things systems and applications, as well as programming languages and tools optimized for the IoT industry. Participants are also exposed to new IoT-specific applications, physical layer protocols, communication technologies, and legacy protocols. This course will primarily present the fundamental IOT architecture building blocks and its theoretical components, such as Raspberry Pi programming using the Python Language Interface and other IOT peripherals.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8483.1 Identify the basic building blocks and its characteristics.
A8483.2 Determine the most appropriate IoT Devices and Sensors based on Application.
A8483.3 Make use of Python standard libraries for implementing various IoT Applications.
A8483.4 Analyze the appropriate protocol for establishing communication between various IoT Devices.
A8483.5 Interpret cloud infrastructure, services, APIs and architectures of commercial and industrial cloud platforms.

3. Course Syllabus

Introduction to Internet of Things: Introduction, Physical Design of IoT, Logical Design of IoT, IoT enabled Technologies, IoT Levels and Templates, IoT Platforms Design Methodology.

Introduction to Python: Language features of Python, Data types & data structures, Control of flow, Functions, Modules, Packages, File Handling, Data/Time operations, Classes, Python packages of interest for IoT(JSON,XML).

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, IoT System Management with NETCONF- YANG-Need for IoT Systems Management, SNMP, Network Operator Requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG.

IoT Physical Devices and Endpoints: Introduction to IoT Device, Exemplary Device: Raspberry Pi, Components of Raspberry Pi Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming – Raspberry Pi with Python.

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs,WAMP – AutoBahn for IoT, Xively Cloud for IoT, ThingSpeak IoT Python web application framework-Django, Designing a RESTful web API.

4. Books and Materials

Text Books:

1. ArshdeepBahga and Vijay Madisetti: Internet of Things,A Hands-on Approach; University Press, 2016
2. Mark Lutz, "Learning Python", 4th edition, OREILLY, 2009.

Reference Books:

1. Getting Started with Raspberry Pi:Matt Richardson & Shawn Wallace,O'Reilly (SPD), 2014.

Course Structure

A8484 - Introduction to Embedded Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	**T**	**P**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Introduction to Embedded systems course introduces the basic concepts like purpose and quality attributes of embedded systems. It covers the differences between the general purpose computers and specific purpose computers and selection of memory according to the requirement for a system. This course presents ASICs, PLDs, COTS, Memory Interface, and communication interface. This course provides a comprehensive introduction to microcontroller (8051) and their architecture with an emphasis on its interfacing with external devices. Focus is on 8051 microcontroller family which includes internal architecture, pin diagram, instruction set, register organization, addressing modes, operating modes, interrupt structure, assembly language programming and etc. Various aspects of hardware design, such as interfacing of memory and different types of I/O devices will be covered in detailed.

Course Pre/co-requisites

A8401 - Digital Logic Design.
A8416 - Computer Organization and Microprocessors.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8484.1 Classify the embedded systems based on the performance, complexity and the era in which they evolved.
A8484.2 Understand different factors to be considered for the selection of memory, sensors, actuators and their interfacing.
A8484.3 Apply the fundamentals of microcontroller to investigate existing designs.
A8484.4 Demonstrate assembly language programming to assemble and driver circuitry to microcontroller I/O ports to interface external devices.
A8484.5 Develop a product with functional requirements using optimal hardware and software components.

3. Course Syllabus

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing,

Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

The 8051 Architecture: Introduction, 8051 micro controller hardware, external memory interfacing, Data transfer and logical instructions, arithmetic operations, decimal arithmetic, jump and call instructions and simple programs. The Assembly Language Programming: Programming tools and techniques, counter and timers programming, interrupts, interrupt programming.

I/O Interfaces: 8051 interfacing with seven segment LED displays, stepper motor, D/A converter interfacing, Interfacing DC motor, Interfacing 4*4 Matrix Keypad, Interfacing to Alphanumeric Displays (LCD) interfacing.

Basic Design Using a Real-Time Operating System: Tasks and Task states, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment, Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System.

4. Books and Materials

Text Books:

1. Introduction to embedded systems Shibu K V Tata Mcgraw-Hill First Edition 2012
2. Kenneth J. Ayala (2008), The 8051 Microcontroller, 3rd edition, Cengage Learning, India.
3. David E. Simon (1999), An Embedded Software Primer, Pearson Education, India

Reference Books:

1. M. A. Mazidi J. G. Mazidi, Rolin D. McKinlay (2000), The 8051 Microcontroller and Embedded System, Prentice Hall of India, New Delhi.
2. Ajay V. Deshmukh (2004), Microcontrollers Theory and applications, Tata McGraw Hill Edition, New Delhi
3. Embedded Systems Rajkamal Tata Mcgraw-Hill Second Edition 2012

Course Structure

A8510 - Operating Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Operating Systems is a graduate-level introductory course that teaches the concepts in operating systems like abstractions, mechanisms, and various services provided. This course deals with Process Management & Synchronization, Inter process communication, Memory Management, Virtual Memory, File & Disk Management and Deadlock handling methods. Using these concepts, the student will be able to understand the internal working of various operating systems. The course provides the concepts and terminology required for advanced courses.

Course Pre/co-requisites

A8506 - Computer Organization

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8510.1. Identify the services provided by the operating system for user and system.
A8510.2. Examine the concepts of IPC and Synchronization for process cooperation
A8510.3. Make use of Memory Management techniques for efficient use of main memory.
A8510.4. Select File and Disk Management methods for effective storage and access.
A8510.5. Identify a Deadlock Handling Method in allocating resources among processes.

3. Course Syllabus

Operating Systems Overview and Process Management: Definition, Operating System Types, Operating System operations, Operating system services, System calls and System Programs. Process concepts- Process, Process State Diagram, PCB and Operations on processes, Process Scheduling- Scheduling Criteria, Scheduler Types and Scheduling Algorithms.

Process Synchronization: Inter Procee Communication- Pipes, Message Passing and Shared Memory. Concept of Synchronization, Critical section problem, Peterson's solution,

Semaphores, Classic problems of Synchronization-The Bounded Buffer Problem, The Readers –Writers Problem, Dining - Philosophers Problem.

Memory Management: Introduction to Memory Management, Swapping, Contiguous Memory Allocation, paging, segmentation, virtual memory, demand paging, Page-replacement algorithms, allocation of frames, thrashing.

File and Disk Management: Concept of a file – File Attributes, File Types, Access Methods, Directory Structures, File System Implementation, Directory Implementation, File Allocation methods, and Free-Space management. Introduction to Magnetic Disks, Disk Structures, Disk Scheduling, Swap Space Management.

Deadlocks: System Model, Deadlock Characterization-Necessary Conditions, Resource Allocation Graph, Deadlock Prevention, Deadlock Avoidance - RAG Algorithm, Banker's Algorithm, Detection- Single Instance ofa Resource type, Multiple Instances of a resource type, recovery from deadlock.

4. Books and Materials

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne., Operating System Concepts, 8th Edition, Wiley India Private Limited, New Delhi,2009.

Reference Books:

1. William Stallings., Operating Systems, Internals and Design Principles, 5th Edition, Pearson Education, India, 2006.
2. Sumitabha Das., Your Unix the Ultimate Guide, Tata Mc Graw Hill, New Delhi, India, 2007.
3. T.Chan., Unix System Programming using C++, PHI, India,1996.

Course Structure

A8514 - Database Management Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the core principles and techniques required in the design and implementation of database systems. This course focus on relational database management systems, including database design theory: E-R modeling, query languages like relational algebra, relational calculus and SQL. It also covers essential DBMS concepts such as: Normalization, Transaction Processing, Concurrency Control, Recovery and tree based indexing techniques like ISAM, B+ trees etc which are required for designing an effective database. Students can undertake a semester project to design, build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Pre/co-requisites

A8608 - Java Programming

A8601 - Object Oriented Programming

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8514.1. Design a database for a given problem using E-R diagrams and Relational Model.
A8514.2. Construct Queries in Relational algebra and SQL for a case study.
A8514.3. Use Normalization techniques to reduce data redundancy in data base.
A8514.4. Select transaction control and recovery methods to keep data base consistent.
A8514.5. Compare various indexing techniques and NoSQL databases for efficient access.

3. Course Syllabus

Introduction and Data Base Design: Introduction to DBMS, applications of DBMS, database systems versus file systems, view of data, Database users and administrators, database system structure. Introduction to Relational database model, database schema, relations, columns and tuples. SQL data types, Database languages, DDL commands, DML commands, DCL commands, TCL commands. Database Design: Introduction to ER model, entities, attributes and entity sets, relationships and relationship sets, additional features of

the E-R model. logical database design: E-R to relational.

SQL Programming: SQL basic operators, SQL set operators-union, intersect and except operators, Integrity constraints in SQL. aggregate operators, GROUP BY, ORDER BY and HAVING Clause, null values, views in SQL, nested queries, SQL joins-inner join, outer join, left outer join, right outer join, storing and retrieving images, storing and retrieving files, Relational algebra operations and basic queries.

Schema Refinement and Normal Forms: Introduction to schema refinement & Normalization, Decomposition and properties of decompositions, functional dependencies, Closure of Attributes set. Normal forms: 1NF, 2NF, 3NF, BCNF, 4NF,5NF. Problems on normalization, Schema refinement in database design. PL/SQL basics for writing triggers, cursors.

Transaction Management: Transaction concept, transaction states, ACID properties, schedules, Serializability-Conflict serializability, View serializability, recoverability. Concurrency control: lock based protocols, timestamp based protocols, deadlocks handling. SQL stored procedures.

Indexing and NoSQL: :Recovery-ARIES recovery algorithm, Log based recovery. File organization techniques, Tree index structures: ISAM and B+ trees. SQL Vs NoSQL, basic CRUD operations using MongoDB.

4. Books and Materials

Text Books:

1. Raghurama Krishnan, Johannes Gehrke., Database Management Systems, 3rd Edition, Tata McGraw-Hill, New Delhi, India, 2014.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan., Database System Concepts, 7th Edition, McGraw- Hill, New Delhi, India, 2019.

Reference Books:

1. Elmasri Navate., Fundamentals of Database Systems, Database System Concepts, 7th Edition, Pearson Education, India,2016.
2. C. J. Date, A. Kannan and S. Swamynathan., An Introduction to Database Systems, 8th Edition, Pearson Education, India, 2015.

Course Structure

A8520 - Software Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course acts as a foundation in the field of software engineering and is aimed at helping students develop an understanding of how software systems are developed from basic, by guiding them through the development process, adopting the fundamental principles of system development. The course will orient the students to the different software process models, software requirements engineering process, systems analysis and design as a problem-solving activity, with focus on quality.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8520.1. Identify the design issues and process models to develop a software.
A8520.2. Determine the functional and non functional requirements with appropriate validation for a software product.
A8520.3. Develop software design documents for the given requirements.
A8520.4. Prepare test documents at various stages to validate project.
A8520.5. Illustrate the need of quality management and metrics for product standardization

3. Course Syllabus

Introduction to Software Engineering: The Evolving nature of software engineering, Changing nature of software engineering, Software engineering Layers, The Software Processes,Software Myths. Process Models: A Generic Process Model, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Spiral Model, the Unified Process.

Requirements Engineering: Functional and Non-Functional Requirements, The Software requirements Document, Requirements Specification, requirements Engineering, Requirements Elicitation and Analysis, Requirement Validation, Requirement Management.

Design and Implementation: System Modeling: Interaction Models, Structural Models, Behavioral Model, Model Driven Engineering. The Object Oriented Design with UML, Implementation Issues. User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

Software Testing Strategies: A Strategic approach to Software Testing, Strategic Issues and Test Strategies for Conventional Software, Validation Testing, Unit Testing , Integration Testing, Regression Testing , The Art of Debugging, White Box Testing - Basic Path Testing, Control Structure Testing. Black Box Testing - Equivalence partitioning, Boundary value analysis, Graph Based testing and state transition testing.

Quality Management: Quality Concepts, Software Quality, Software Quality Dilemma, Achieving Software Quality, Review Techniques, Reviews: A Formal spectrum, Informal Reviews, Formal Technical Reviews. Software Quality Assurance: Background Issues,Elements of Software Quality Assurance, Tasks, Goals and Metrics, Software Reliability,the ISO 9000 Quality Standards.

4. Books and Materials

Text Books:

1. Roger S. Pressman.,Software Engineering, A Practitioner's approach , 7th Edition, McGraw Hill International Edition, New Delhi,2011.
2. Sommerville., Software Engineering, 9th Edition,Pearson education, India.

Reference Books:

1. K. K. Agarval, Yogesh Singh., Software Engineering, 3rd Edition, New Age International Publishers, India,2007.
2. Lames F. Peters, Witold Pedrycz, Software Engineering an Engineering approach,John Wiely & Sons, New Delhi, India,2000.
3. Shely Cashman Rosenblatt., Systems Analysis and Design, 6th Edition, Thomson Publications, India.

Course Structure

A8607– Information Security

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Information security is the practice of protecting information by mitigating risks across computer systems. The course introduces the technical and policy foundations of information network security. This course explains the inner workings of cryptographic systems and how to correctly use them in real-world applications.

Course Pre/co-requisites

A8519 - Computer Networks.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8607.1 Recognize various security threats, services, mechanisms, and classical encryption techniques.

A8607.2 Apply classical encryption algorithms (Substitution and Transposition ciphers) and DES, AES algorithms to encrypt plain text.

A8607.3 Explain various key management techniques, exemplifying RSA and Diffie-Hellman.

A8607.4 Examine the problems of authentication techniques (SHA, Digital signature).

A8607.5 Analyze different symmetric key distribution and understanding of various authentication applications

3. Course Syllabus

Introduction to Information Security: Computer security concepts, OSI security architecture,security attacks, security services, security mechanisms, a model for network security.Classical Encryption Techniques: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques.

Block Cipher and Data Encryption Standards: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles, tools used for DES.Advanced Encryption Standards: Advanced Encryption Standard, Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES Key Expansion, tools used for AES.Blowfish Algorithm,International Data Encryption Algorithm(IDEA).

Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, extended Euclid's algorithm. Public-Key Cryptography

and RSA: Principles of Public key crypto Systems, RSA algorithm, Diffie-Hellman Key Exchange.

Hash Functions: Cryptographic Hash Functions, Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA). Digital Signature: Digital Signature Requirements, Attacks and Forgeries, Properties.

Key Management and Distribution : Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security Email Security:Pretty Good Privacy (PGP).

4. Books and Materials

Text Books:

1. William Stallings, Cryptography and network security: principles and Practice Upper Saddle River: Pearson, 6th edition.

Reference Books:

1. Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and network security (Sie).McGraw-Hill Education, 2011.
2. AtulKahate., Cryptography and Network Security, 2nd edition, Tata Mc-Grawhill, India,2008.

Course Structure

A8608 - Java Programming

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides Object Oriented Programming concepts using Java. The course focuses on different aspect of core Java Environment suitable to write efficient, maintainable, and portable code. It also ignites Object Oriented thinking and explores with the evolution of Java and its basics. It provides strong foundation on Inheritance, Packages and Interfaces and also illustrates Exception Handling and Multithreaded mechanisms. It also provides Collection framework for manipulating data. This course also focuses on file handling using Java API.

Course Pre/co-requisites

A8505 - Data Structures

A8508 - Python Programming Laboratory

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8608.1 Make use of various constructs to write a console application.
A8608.2 Use principles of OOP to develop real time applications.
A8608.3 Identify the need of exception handling to deal with runtime errors.
A8608.4 Build applications for parallel processing using Multithreading.
A8608.5 Choose Collection framework and I/O to manipulate and store data.

3. Course Syllabus

Introduction to OOP : Evolution of Java, OOP principles, Java Buzzwords, Implementing Java program, JVM, Data Types, Variables, Type conversions and Casting, Operators, Control statements, Arrays. Classes, Objects, Methods, Constructors, this keyword, Overloading Methods and Constructors, Argument passing, Exploring String class.

Inheritance, Interfaces and Packages: Inheritance- Inheritance Basics, Using super, Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Abstract classes, final keyword. Packages and Interfaces: Defining a Package, Finding Packages and CLASSPATH,

Access Protection, Importing Packages, Defining and Implementing interfaces, Extending interfaces.

Exception Handling: Exception Handling Fundamentals, Exception Types, using try catch, throw throws and finally keywords, Built-in Exceptions, Creating own exception subclasses.

Multithreading: Multithreading: Multithreading- Life cycle of a thread, Thread class methods, creating threads, thread priorities, Synchronizing threads, Interthread Communication.

Collections and I/O : Collections - Introduction to Collection Framework, Collections Hierarchy, ArrayList, LinkedList, HashSet, TreeSet. The Date and StringTokenizer. I/O – Basics, reading and writing console input and output, PrintWriter class, operations of files – reading, writing and copying files.

4. Books and Materials

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, Tata McGraw-Hill Education, 2019.

Reference Books:

1. Y.Daniel Liang, Introduction to Java Programming-Comprehensive Version, 10th Edition,Pearson Education,2018.
2. Kathy Sierra, Bert Bates, OCA Java SE 8 Programmer, 1st Edition, McGraw-Hill Education, 2017.

Course Structure

A8651 - Ethical Hacking

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Ethical hacking strikes all of us as a subject that requires a great deal of prerequisite knowledge about things like heavy duty software, languages that includes hordes of syntaxes, algorithms that could be generated by maestros only. Well that's not the case, to some extent. This course introduces the steps required to complete a penetration test, or ethical hack. Requiring no prior hacking experience, the book explains how to utilize and interpret the results of modern day hacking tools that are required to complete a penetration test. Coverage includes GoogleHacking, Nmap, Nessus, Metasploit, and Hacker Defender rootkit. Simple explanations of how to use these tools and a fourstep methodology for conducting a penetration test provide readers with a better understanding of offensive security.

Course Pre/co-requisites

A8519-Computer Networks

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8651.1 Use the various security tools to assess the computing system.
A8651.2 Identify the vulnerabilities across any computing system using penetration testing.
A8651.3 Choose a prediction mechanism to prevent any kind of attacks.
A8651.4 Make use of metasploit tool to probe systematic vulnerabilities on networks and servers.
A8651.5 Identify the wireless network flaws and fill security patches in web access.

3. Course Syllabus

Introduction to Hacking: Important Terminologies, Penetration Test, Vulnerability Assessments versus Penetration Test, Pre-Engagement, Rules of Engagement, Penetration Testing Methodologies, OSSTMM, NIST, OWASP, Categories of Penetration Test, Types of Penetration Tests, Vulnerability Assessment Summary Reports.

Information Gathering Techniques: Information Gathering Techniques, Active Information Gathering, Passive Information Gathering, Sources of Information Gathering, Information Gathering with Whois, Tracing the Location, Traceroute, ICMP Traceroute, TCP Traceroute, Usage, UDP Traceroute, Enumerating and Fingerprinting the Webservers, Google Hacking.

Network Attacks: Vulnerability Data Resources, Exploit Databases, Network Sniffing, Types of Sniffing, Promiscuous versus Nonpromiscuous Mode, MITM Attacks, ARP Attacks, Denial of Service Attacks, Hijacking Session with MITM Attack, SSL Strip: Stripping HTTPS Traffic, DNS Spoofing, ARP Spoofing Attack Manipulating the DNS Records, DHCP Spoofing, Remote Exploitation, Attacking Network Remote Services, Overview of Brute Force Attacks, Traditional Brute Force, Attacking SMTP.

Exploitation: Introduction to Metasploit, Reconnaissance with Metasploit, Port Scanning with Metasploit, Compromising a Windows Host with Metasploit, Client Side Exploitation Methods, e- Mails with Malicious Attachments. .

Wireless and Web Hacking: Wireless Hacking, Introducing Aircrack, Cracking the WEP, cracking a WPA/WPA2 Wireless Network Using Aircrack-ng, Brute Force and Dictionary Attacks, Types of Authentication.

4. Books and Materials

Text Books:

1. Rafay Baloch., Ethical Hacking and Penetration Testing Guide, CRC Press, 2014.

Reference Books:

1. Kevin Beaver, Ethical Hacking for Dummies,6th Edition,Wiley, 2018.
2. Jon Erickson., Hacking: The Art of Exploitation, 2nd Edition, Rogunix, 2007.

Course Structure

A8652 - Cyber Security

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides a comprehensive overview of various cybercrimes, how they are planned, possible vulnerabilities and crimes that occur in mobile and wireless devices. It introduces tools and techniques that are used in cybercrime. It helps in analyzing and designing defensive security mechanisms for protecting information systems resources.

Course Pre/co-requisites

A8519- Computer Networks
A8607- Information Security

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8652.1 Identify the cybercrimes and offences in network accesses.
A8652.2 Interpret the criminal plans before going to attack.
A8652.3 Choose various security measures on mobile devices for a given scenario and make an effective report.
A8652.4 Identify the various methods and tools in Cyber Crime.
A8652.5 Examine various defense and analysis techniques to protect our information from attackers

3. Course Syllabus

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, who are Cybercriminals, Classifications of Cybercrimes. Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector, and Cloud Computing.

Cybercrime -Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Defense and Analysis Techniques: Memory Forensics - Why Memory Forensics Is Important, Capabilities of Memory Forensics, Memory Analysis Frameworks, Dumping Physical Memory, Installing and Using Volatility, Finding Hidden Processes, Volatility Analyst Pack, Honey pots, Intrusion Detection Systems.

4. Books and Materials

Text Books:

1. Nina Godbole and Sunil Belapure., Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Prespectives,1st Edition,Wiley INDIA, 2011.
2. James Graham, Richard Howard and Ryan Otson., Cyber Security Essentials,1st Edition,CRC Press,2011.

Reference Books:

1. Chwan-Hwa(John), Wu,J.David Irwin., Introduction to Cyber Security,1st Edition, CRC Press T and F Group, 2013.
2. Richard A. Clarke, Robert Knake., Cyberwar: The Next Threat to National Security and What to Do About It,Ecco 2010.

Course Structure

A8656 - Blockchain Technology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces blockchain, a revolutionary technology that enables peer-to-peer transfer of digital assets without any intermediaries, and is predicted to be just as impactful as the Internet. A blockchain is a permanent, sequential list of transaction records distributed over a network. The course introduces consensus, proof of work, mining, in Bitcoin. The course introduces ethereum blockchain and smart contracts.

Course Pre/co-requisites

A8607 - Information Security

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8656.1 Identify the basic concepts of block chain to process data
A8656.2 Make use of Bitcoin as cryptocurrency
A8656.3 Choose Ethereum block chain for security
A8656.4 Design smart contracts as per the requirements and deploy on Testnet works.

3. Course Syllabus

Introduction to Cryptocurrencies: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency. How Bitcoin Achieves Decentralization: Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity: the Block Chain, Incentives and Proof of Work, Putting It All Together.

Mechanics of Bitcoin: Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations Improvements. Store Usage: How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Bitcoin Mining: The Task of Bitcoin Miners, Mining Hardware, Energy Consumption Ecology, Mining Pools, Mining Incentives and Strategies. Bitcoin and Anonymity: Anonymity Basics, How to de-anonymizeBitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash, Tor and the Silk Road.

Ethereum: What is Ethereum, smart contracts, Solidity Ethereum Virturalmachine. Installing solidity ethereum wallet, basics of solidity by example, Layout of a solidity source file

structure of smart contracts, General value types, ether units, Time units, Globally available variables and functions.

Operators: Arithmetic, Logical Bitwise operators, Control structure (if-else, for, while, do-while), Scoping and declarations, Input parameters and output parameters, Function calls return types, Function Modifiers, Fallback functions, Abstract contract, Creating contracts via new operator, Inheriting smart contracts, Importing smart contracts compiling contracts, Events logging, exceptions, Examples of smart contract : crowd funding, voting ballot.

4. Books and Materials

Text Books:

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., Goldfeder, S.,Bitcoin and cryptocurrency technologies: a comprehensive introduction, Princeton University Press, 2016.
2. Dave Hoover, Kevin Solorio, and Randall Kanna., Hands–On Smart Contract Development with Solidity and Ethereum, O'Reilly Media, Inc., 2019.

Reference Books:

1. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 1st Edition, O'Reilly Media, Inc., 2019.

Course Structure

A8658 - Robotic Process Automation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

RPA is an advanced form of business process automation that can provide a path for businesses to automate human actions. RPA is ultimately about automating some of the most mundane and repetitive computer-based tasks and processes in the workplace like text, image automation with sequence of actions, keyboard-based automation, and E-mail automation etc. Process automation is able to record tasks performed by a human on their computer, then perform those same tasks without human intervention.This course will help Students to learn how to Automate the Tasks in real time.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8658.1. Discuss use of RPA platform and its components.
A8658.2. Apply sequence and control flows as per the requirements.
A8658.3. Analyse data manipulation concepts to solve real time problems.
A8658.4. Illustrate user interface explorer and handle events.
A8658.5. Demonstrate scenario of handling the errors and exceptions and benefits of RPA.

3. Course Syllabus

Introduction to Robotic Process Automation: Scope and techniques of automation, Benefits of RPA, Components of RPA, RPA platforms, About UiPath. Record and Play: UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio,Task recorder, Step-by-step examples using the recorder.

Sequence & Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-Step example using Sequence and Flowchart, Step-by step example using Sequence and Control flow.

Data Manipulation: Variables and scope, Collections, Arguments-purpose and use,Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example).

Handling events: Element triggering events, image triggering events, system triggering events, PDF Extraction, Revisit Recorder: Basic recording, Desktop recording, web recording, Screen Scraping, Automation Techniques: Incoming Email automation, Sending Email automation, Workbook and Excel automation (read/write).

Error and Exception Handling: Exception handling, Common exceptions and ways to handle them,debugging techniques, Collecting crash dumps, Error reporting. Future of RPA,RPA Compared to BPO, BPM and BPA

4. Books and Materials

Text Books:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940.
2. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA System, Publisher: A press,2020.

Reference Books:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant.
3. SrikanthMerianda,Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

Web Resources:

1. https://www.uipath.com/rpa/robotic-process-automation

Course Structure

A8681 - E-Commerce

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The tremendous growth of the Internet and World Wide Web is making a great impact on businesses, governments and individuals throughout the world. In this course, students will understand the phenomena, technological, economic and social, behind these rapid changes, and how organizations successfully conduct Internet-based activities. This course discusses some of the technology of the Internet. This course provides an overview of e-commerce from both technological and managerial perspectives. It introduces e-commerce frameworks and technological foundations; and examines basic concepts such as strategic formulation for e-commerce enterprises, management of their capital structures and public policy. It is particularly important that the students emphasis on understanding the different E-Commerce system design principles.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8681.1. Elaborate the components and roles of the E-Commerce environment.
A8681.2. Estimate how to sell products and services on the web as well as to meet the needs of website visitors.
A8681.3. Analyze the impact of E-commerce on business models and strategy.
A8681.4. Create a portfolio of the steps required to start-up an on-line business.
A8681.5. Interpret legal and ethical issues related to E-Commerce and web marketing approaches.

3. Course Syllabus

Introduction to E-Business and E-Commerce: What is the difference between e-commerce and e-business, Anatomy of E-Commerce applications, E-Business risks and barriers to business adoption, Management responses to E-Commerce and E-Business, Electronic Commerce-Frame work.

E-Commerce Fundamentals: Location of trading in the marketplace, Business models for ecommerce, Focus on auction business models, Focus on Internet start-up companies. E-Business Infrastructure - Introduction, Internet technology, Web technology, Internet-access software applications, Managing e-business infrastructure, Focus on web services, SaaS and service oriented Architecture (SOA), Focus on mobile commerce.

E-Environment: Social and legal factors, Environmental and green issues related to Internet Usage, Focus on e-commerce and globalization, Political factors.
E-Business Strategy - What is e-business strategy, Strategic analysis, Strategic objectives, Strategy definition, Strategy implementation, Focus on information systems strategy and e-business strategy.

E-Security: Securing the Business on Internet- Security Policy, Procedures and Practices, Transaction Security, Cryptology, Digital Signatures, Security Protocols for Web Commerce. Supply Chain Management- What is supply chain management?,Focus on the value chain, Using e- business to restructure the supply chain, Supply chain management implementation

E-Procurement: What is e-procurement, Drivers of e-procurement, Focus on estimating eprocurement cost, implementing e-procurement.

4. Books and Materials

Text Books:

1. Dave Chaffey., E-Business and E-Commerce Management , strategy, Implementation and practice, 5th Edition, Prentice Hall,2011.

Reference Books:

1. E-Commerce fundamentals and applications Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth - 215 - Chang, JohnWiley.
2. Whinston,Pearson., Frontiers of electronic commerce –Pearson Education, Kalakata,2015.
3. Bharat Bhaskar: Electronic Commerce,TataMc-Graw-Hill, New Delhi, 2003
4. E-Commerce — Business, Technology, Society, Kenneth C.Taudon, Carol Guyerico-Traver.

Course Structure

A8682 - Full Stack Development

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The popularity of JavaScript has brought many advancements and changed the face of web development. Real-world applications are looking at the web design with push capabilities. The purpose of this course is to study the concepts of JAVASCRIPT, React JS and Node JS to build user interface web-based applications to meet real-world needs.

Course Pre/co-requisites

A8604 - Web Technologies

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8682.1 Demonstrate the fundamentals of scripting languages & non - scripting languages and its differences.
A8682.2 Use react concepts to design forms.
A8682.3 Use different node.js modules to connect with database.
A8682.4 Build web application using Node.js.

3. Course Syllabus

Introduction: Introduction to scripting language, motivation , applications; scripting languages vs non-scripting languages; overview of popular scripting languages-JavaScript, Perl, Python; environments - Node.js and react.js, java scripting language constructs.

React JS: JSX and its use case, DOM, Virtual DOM and its working, ES6, Difference between ES5 and ES6, NPM Modules, React Elements, Render Function, Redux ,ReactJS with Redux.

React JS: Components, Class Component, Props, Events, Forms, CSS, Hooks & Context API, Material UI.

Node.JS: Concepts-modules, packages, working with HTTP, streams and file systems,

events, REST API, ExpressJS.

Node.JS: Database connectivity-Mysql, create connection, create database, working with Database operations-create table, insert, select, update, delete, etc.s

4. Books and Materials

Text Books:

1. Learning Node.js A Hands on Guide to Building Web Applications in JavaScript, Marc Wandschneider, Second Edition, Addinson-Wesley.
2. React.js Book: Learning React JavaScript Library From Scratch, Greg Sidelnikov, Learning Curve, 2017.

Reference Books:

1. Beginning Node.js, Basarat Ali Syed, Apress, 2004.
2. The Node Beginner Book: A Comprehensive Node.js Tutorial, Manuel Kiessling, Leanpub, 2011.
3. FullStack React: The Complete Guide to ReactJS and Friends, Anthony Accomazzo, Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Guttman, and Tyler McGinnis.
4. Learning React: Functional Web Development with React and Redux, Alex Banks & Eve Porcello, O'Reily.

Course Structure

A8702 – Artificial Intelligence

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This is an undergraduate course to acquire the ability to design intelligent solutions to problems in a variety of domains and business applications such as natural language Processing, text mining, and robotics, reasoning and problem-solving. AI will focus on problem solving, reasoning, planning and gaming. Through learning problem solving skills can be acquired. The course enables to choose data science domain to implement machine learning and deep learning applications.

Course Pre/co-requisites

A8508-Python Programming Laboratory
A8509-Discrete Mathematical Structures

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8702.1. Apply AI techniques to solve game playing theorem proving and machine learning.
A8702.2. Apply the propositional logic to AI designs .
A8702.3. Learn different playing and reinforcement learning techniques .
A8702.4. Examine the role of searching strategies in AI environment.
A8702.5. Analyse the constraint satisfaction problems for problem solving.

3. Course Syllabus

Introduction: Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

Adversarial Search : Games, Optimal decisions in games, The minimax algorithm, Alpha–Beta pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking search for CSPs, Knowledge-Based Agents, The wumpus world.

Propositional Logic: Inference and proofs, Proof by resolution, Horn clauses and definite clauses. First-Order Logic : Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Planning: Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning ,Graphs, Analysis of Planning approaches, Hierarchical Planning.

Reinforcement learning: Introduction, passive Reinforcement learning, active Reinforcement learning, Generalization in reinforcement learning. Robotics: Introduction, Robot Hardware, Robot Perception, planning to move, moving Robotic Software Architectures.

4. Books and Materials

Text Books:

1. Stuart J.Russel, Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education, 2009.

Reference Books:

1. E.Rich and K.Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2008.
2. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, Pearson Education Private Limited, India, 2001.
3. George F. Luger , Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th Edition, Pearson, 2008.
4. Shivani Goel, Artificial Intelligence, 4th Edition, Pearson Education Private Limited, India, 2009.

Course Structure

A8781- Computer Organization and Architecture

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	3	40	60	100

1. Course Description

Course Overview

This course is designed to understand the concepts and functionalities of computer system among the various components such as registers, control unit and memory units. The course provides in-depth knowledge of internal working, structuring, and implementation of a computer system, the way the system is structured so that all those catalogued tools can be used properly. In addition, this course helps to construct the circuits to the corresponding operations and also discusses the multiprocessing. It is a fundamental course and provides the concepts and terminology required for advanced courses.

Course Pre/co-requisites

A8402 - Digital Electronics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8781.1. Identify various functional aspects of computer hardware.
A8781.2. Choose various instructions and addressing modes to execute an instruction.
A8781.3. Make use of integer and floating point algorithms to perform arithmetic operations on data.
A8781.4. Design control unit and memory for a computer system.
A8781.5. Examine the performance of a system using pipelining and multiprocessors.

3. Course Syllabus

Introduction and Micro operations: Computer functional units, Von – Neumann Architecture, Harvard architecture. Register transfer, Bus and memory transfer, arithmetic micro operations, logic micro operations, shift micro operations, arithmetic logic and shift unit. Data Representation – Fixed point and Floating point.

Instructions and Addressing Modes: Computer Instructions, Instruction Cycle, Register reference instructions, Memory reference instructions, Input-output and Interrupt. Stack organization, instruction formats, addressing modes, data transfer and manipulation, Inter-

rupt Handling and types.

Computer Arithmetic: Introduction, Addition, Subtraction and Multiplication algorithms on signed magnitude and two's complement data, Division Algorithms, Floating point arithmetic operations.

Control Unit and Memory Organization: Control memory, address sequencing, micro program example and design of control unit. Memory Hierarchy, Main Memory – RAM and ROM chips, Cache Memory – Introduction, Cache Mapping Techniques.

Pipelining and Multiprocessors: Parallel processing, Arithmetic Pipeline, Instruction pipeline and RISC pipeline. Multiprocessors- characteristics of multiprocessors, Interconnection structures, Interprocessor arbitration.

4. Books and Materials

Text Books:

1. M. Moris Mano., Computer System Architecture,3rd Edition, Pearson Publication, India, 2006.
2. Stallings William., Computer Organization and Architecture,9th Edition, Pearson Education India, 2012.

Reference Books:

1. Carl Hamacher, ZvonksVranesic, SafeaZaky., Computer Organization,5th Edition, McGraw-Hill, New Delhi, India, 2002.

Course Structure

A8851 - Data Science for Engineers

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Data Science for Engineers course aims to equip engineering students with the essential knowledge and practical skills required to excel in the dynamic field of data science, emphasizing their ability to proficiently query and analyze diverse datasets. Through this course, students will gain a comprehensive understanding of the intricacies involved in handling heterogeneous data, learning how to effectively preprocess and visualize it. By exploring the methodologies and tools employed in data science, students will not only grasp the theoretical foundations but also engage in hands-on applications. Ultimately, upon completing this course, students will emerge with a well-rounded skill set that encompasses data querying and analytics, data preprocessing and visualization, and a solid foundation in data science methodologies and tools. This comprehensive preparation equips them to navigate the complex landscape of data science effectively and contribute meaningfully to data-driven decision-making processes.

Course Pre/co-requisites

A8005- Computer Oriented Statistical Methods
A8514- Database Management Systems
A8804- Data Analytics

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8851.1 Identify the various requirements for data science process.
A8851.2 Choose an appropriate database required for processing data.
A8851.3 Demonstrate the data science methodology and text mining approaches.
A8851.4 Make use of data science tools to visualize the insights of data.
A8851.5 Apply various data visualization techniques using Tableau over Google Sheets.

3. Course Syllabus

Importance of Data Science: Need for Data Science, what is Data Science? Data Science Process, Business Intelligence and Data Science, Prerequisites for a Data Scientist, Components of Data Science, Tools and Skills needed. Statistics and Probability- Data Types, Variable Types, Statistics, Sampling Techniques and Probability, Information Gain and Entropy, Probability Theory, Probability Types, Probability Distribution Functions, Bayes' Theorem, Inferential Statistics.

Databases for Data Science: SQL – Tool for Data Science, Basic Statistics with SQL, Data Munging with SQL, Filtering, Joins, and Aggregation, Window Functions and Ordered Data, Preparing Data for Analytics Tool, Advanced NoSQL for Data Science- Why NoSQL, Document Databases for Data Science, Wide-Column Databases for Data Science, Graph Databases for Data Science.

Data Science Methodology: Analytics for Data Science, Examples of Data Analytics, Data Analytics Life Cycle- Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalization. Data Analytics and Text Mining- Text Mining, Major Text Mining Areas, Text Analytics, Major Components of NLP, Stages of NLP, Statistical Processing of Natural Language, Applications of NLP.

Data Science Tools-I: Python Libraries: DataFrame Manipulation with pandas and NumPy, Data Wrangling: Clean, Transform, Merge, Reshape, Exploration Data Analysis with Python, Time Series Data, clustering with Python, Plotting and Visualization, ARCH and GARCH, Dimensionality Reduction.

Data Science Tools-II: Tableau- Introduction to Data Visualization and Tableau, Dimensions and Measures, Cleaning and Structuring Messy Data Descriptive Statistics, Basic Charts, Joins and blends, Filtering data, Row-level calculations, Aggregate-level calculations, Level of detail calculations, Custom Table Calculations, Dashboard Design & Principles, Special Chart Types, Integrate Tableau with Google Sheets.

4. Books and Materials

Text Books:

1. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, Fundamentals of Data Science, 1st Edition,CRC Press, India,2022.
2. Wes McKinney., Python for Data Analysis, 1st Edition,O'Reilly Publications, 2015.
3. Joshua N. Milligan, Learning Tableau 2019, Packt Publications,2019.

Reference Books:

1. Avrim Blum, John Hopcroft, Ravindran Kannan., Foundations of Data Science, 1st Edition, Cambridge University Press, 2020.
2. Ani Adhikari and John DeNero,Computational and Inferential Thinking: The Foundations of Data Science,GitBook, 2019.

Course Structure

A8081 - Mathematical Programming

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the Linear programming problem, Formulation and Graphical solution of Linear programming problem, Simplex method, Big -M method, Two-phase simplex method, Dual simplex method, Degeneracy in simplex and unbounded solutions, Transportation problem, Assignment model, Replacement models and Sequencing models. In addition, this course can be applied in many areas of engineering such as computer graphics, cryptography.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8081.1. Identify LPP and express in mathematical form to solve by graphical or simplex method.
A8081.2. Apply artificial variable techniques to obtain the optimal solution of an LPP.
A8081.3. Interpret various methods under transportation model to get optimal results.
A8081.4. Solve travelling salesmen problem using Hungarian method.
A8081.5. Develop various replacement and sequencing models to arrive at an optimal decision.

3. Course Syllabus

Introduction to Operations Research: Basic definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem, Formulation and Graphical solution of Linear Programming Problem, Simplex method.

Artificial Variables Techniques: Big -M method, Two-phase simplex method, Duality in simplex method, Dual simplex method, degeneracy in simplex and unbound solutions.

Transportation problem: Formulation, solution, unbalanced Transportation problem. Finding initial basic feasible solutions, North-West corner rule, lowest cost entry method and Vogel's approximation method. Optimality test- MODI method, degeneracy in transportation, restricted transportation problem, conditional transportation problem.

Assignment Model: Formulation, Hungarian method for optimal solution, solving unbalanced problem, restricted assignment, conditional assignment problems, crew assignment problems, Travelling salesman problem, Transportation problem as assignment problem.

Replacement Models and Sequencing Models: 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. Sequencing Models: Solution of Sequencing Problem, Processing n Jobs through two machines, Processing n Jobs through three machines, Processing two Jobs through m machines, Processing n Jobs through m Machines.

4. Books and Materials

Text Books:

1. Sharma S. D. Operation Research, Tata McGraw Hill, New Delhi, 2009.
2. Panneerselvam R. Operations Research, 2nd Edition, Prentice Hall of India, India, 2008.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. Sharma J. K. Operations Research – Theory and Applications, 5th Edition, Macmillan India Ltd, India, 2007.

Course Structure

A8082 - Transform Calculus

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the Series Solutions of Second Order Ordinary Differential Equations, Fourier Series, Fourier Transforms, Z-Transforms and Applications of Transforms to Integral equations. In addition, this course can be applied in many areas of engineering such as computer graphics, cryptography, wireless communication, signal processing, robotics and animation.

Course Pre/co-requisites

A8002 - Ordinary Differential Equations and Vector Calculus.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8082.1. Formulate series solutions of ordinary differential equations.
A8082.2. Develop Fourier series for different types of functions.
A8082.3. Apply Fourier Transform to connect the time and frequency domain.
A8082.4. Analyze Z-transform and discrete signals to solve equations.
A8082.5. Apply Laplace transforms to solve integral equations.

3. Course Syllabus

Series Solutions of Second Order Ordinary Differential Equations: Classification of Singularities, Series Solutions to Differential Equations around zero, Frobenius Method around zero.

Fourier Series: Euler's formulae, Dirichlet's conditions, Fourier series for functions having period , Fourier series for even and odd functions, Half range Fourier sine and cosine series.

Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms, Finite Fourier transforms.

Z-Transforms: Definition, Some standard Z-transforms, Damping rule, Shifting rule, Multiplication by n , Initial and final value theorems. Inverse Z-transforms using partial fractions, Convolution theorem, Solution of difference equations by Z - transforms.

Applications of Transforms to Integral equations: Integral equations, Abel's Integral equations, Integral equation of convolution type, Integro differential equations, Applications

of Transforms to Integral equations.

4. Books and Materials

Text Books:

1. Grewal,B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Jain, R.K. and Iyengar, S.R.K. Advanced Engineering Mathematics, Narosa Publishing House, 2015.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. Ramana, B.V. Higher Engineering Mathematics, 23rd Reprint,Tata Mc-GrawHill Education Private Limited, New Delhi, 2015.

Course Structure

A8083 - Numerical Techniques

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course offers more advanced topics of mathematics required to analyze the problems in engineering. Topics to be covered in this course include: Solution of algebraic and transcendental equations, system of linear equations, Interpolation, Numerical differentiation and integration, curve fitting, Numerical solutions of ordinary and partial differential equations. The mathematical skills derived from this course provides necessary base to analytical and theoretical concepts occurring in the program.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8083.1	Apply numerical methods to obtain approximate solutions of algebraic and transcendental equations
A8083.2	Make use of interpolation techniques to find approximate values and derivatives of the function at intermediate points
A8083.3	Compute an approximate value of a definite integral using numerical integration
A8083.4.	Construct curve of best fit for the experimental data using method of least squares
A8083.5.	Select an appropriate numerical method to solve ordinary and partial differential equations.

3. Course Syllabus

Solution of Algebraic, Transcendental Equations and System of Linear Equations: Bisection method, Regula-falsi method, Iteration method, Newton - Raphson method. Iterative methods of solution of system of equations: Jacobi's iteration method, Gauss-Seidel iteration method.

Interpolation: Finite differences: Forward, Backward and Central differences, Other difference operators and relations between them, Differences of a polynomial, Missing terms, Newton's interpolation formulae, Interpolation with unequal intervals: Lagrange's interpolation formula.

Numerical Differentiation, Integration and Curve fitting: Numerical differentiation: Derivatives using Newton's interpolation formulae. Numerical integration: Newton-Cote quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth

rule. Curve Fitting: Method of least squares, Fitting a straight line, Second degree parabola and Non-linear curves of the form $y = ae^{bx}, y = ab^x, y = ax^b$ by the method of least squares

Numerical Solution of Ordinary Differential Equations of First Order: Taylor's series method, Picard's method, Euler's and modified Euler's Method, Runge-Kutta method of fourth order, Predictor and Corrector methods: Milne's method, Adams-Bashforth-Moulton method.

Numerical Solution of Partial Differential Equations: Finite difference approximations to partial derivatives, Elliptic equations: Solution of Laplace equation by Liebmann's iteration process, Parabolic equations: Solution of one dimensional Heat equation by Schmidt explicit method and Crank-Nicolson implicit method.

4. Books and Materials

Text Books:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. M.K. Jain, S.R.K Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, 5rd Edition, New Age International Publishers, New Delhi, 2007.

Reference Books:

1. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Ramana, B.V. Higher Engineering Mathematics, 23nd Reprint, Tata McGraw Hill Education (India) Pvt Ltd, New Delhi, 2015.
3. T.K.V. Iyengar, B. Krishna Gandhi & Others, Numerical Methods, 2nd Revised Edition, S Chand & Company Ltd, New Delhi, 2013.

Course Structure

A8084 - Entrepreneurship Development

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims to provide students with an understanding of the nature of enterprise and entrepreneurship and introduces the role of the entrepreneur, will inculcate the knowledge of government supporting programs like financial assistance by public sector banks. Apart from this, students learn about the women entrepreneurs and success stories of women entrepreneurs, gain the knowledge of project management and profitability appraisal, focus on importance of training the new entrepreneurs as well as existing entrepreneurs.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8084.1 Identify the role, characteristics, qualities and functions of entrepreneur.
A8084.2 Interpret various Institutional supports for setting up a business enterprise.
A8084.3 Illustrate role, importance and functions of women entrepreneur.
A8084.4 Infer the concept of Project Management and steps in Project development.
A8084.5 Indicate training programs and different training institutions to impart training.

3. Course Syllabus

Entrepreneurship: Importance and role of entrepreneurship, Qualities of an entrepreneur, Functions of entrepreneur, Theories of entrepreneurship, Stimulants of entrepreneurship and Barriers to entrepreneurship, Ethics and Social Responsibility, Role of entrepreneur in economic development.

Institutional Support: Role of Government: Role of IDBI, SIDBI, SIDO, NIESBUD, DIC, Entrepreneurship Development Institute, T-Hub (Telangana Hub).

Women Entrepreneurship: Role & Importance, Functions of women entrepreneur, Profile of Indian Women Entrepreneur, Problems of Women Entrepreneurs, Women Entrepreneurship Development in India and in Foreign Countries.

Project Management: Concept of project and classification of project, Project life cycle identification, Project formulation, Project report, Project evaluation- profitability appraisal, social cost benefit analysis, feasibility analysis, financial analysis and project financ-

ing, Project implementation, Project completion.

Entrepreneur Training: Designing appropriate training programmes to inculcate Entrepreneurial Spirit, significance of entrepreneurial training, Feedback and Performance of Trainees, NSIC, Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Telangana Academy for Skill and Knowledge (TASK).

4. Books and Materials

Text Books:

1. Robert Hisrich, Michael P. Peter, Dean A. Shepherd (2010), Entrepreneurship, Tata Mc Graw Hill, New Delhi

Reference Books:

1. Bholanath Datta (2009), Entrepreneurship, Excel publications, India.
2. David H Holt (2010), Entrepreneurship, Prentice hall of India, New Delhi, India

Course Structure

A8085 - Logistics and Supply Chain Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The LSCM deals with effective management, organizing and monitoring of storage and distribution of goods. It imparts knowledge on the various functions of logistics management. It educate on designing of the supply chain network. it gives clarify the significance of establishing global supply chain. Also it will highlight the role of information technology in supply chain. The aim is to manage the entire order cycle in the most efficient way so that it enhances business development and ensures sustainability and customer satisfaction.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8085.1. Understand the cyclical perspective of logistics and supply chain process.
A8085.2. Learn about the distribution, transportation, warehousing related issues and challenges in supply chain.
A8085.3. Appreciate the significance of network design in the supply chain.
A8085.4. Gain knowledge of various models/tools of measuring the Supply Chain Performance.
A8085.5. Appreciate the role of coordination and technology in supply chain management.

3. Course Syllabus

Understanding Supply Chain: Objectives of a Supply Chain, Importance, Stages of Supply Chain, Value Chain Process, Cycle View of Supply Chain Process, Key Issues in SCM, Logistics & SCM, Supply Chain Drivers and Obstacles, Supply Chain Strategies, Strategic Fit, Best Practices in SCM, Obstacles of Streamlined SCM, Green Supply Chain Management, Supply Chain Sustainability – case study.

Logistics: Evolution, Objectives, Components and Functions of Logistics Management, Difference between Logistics and Supply Chain, Distribution related Issues and Challenges. Gaining Competitive Advantage through Logistics Management. TRANSPORTATION: Functions, Costs, and Mode of Transportation Network and Decision, Models, Containerization, Cross Docking, Reverse Logistics. Outsourcing: Nature and Concept, Strategic Decision to Outsourcing, Third-party Logistics (3PL), Fourth-party Logistics (4PL) - case study.

Designing the Supply Chain Network: Designing the Distribution Network ,Role of Distribution, Factors Influencing Distribution, Design Options, e-Business and its Impact, Distribution Networks in Practice, Network Design in the Supply Chain, Role of Network, Factors Affecting the Network Design Decisions ,Modeling for Supply Chain - case study.

Supply Chain Performance: Bullwhip Effect and Reduction, Performance Measurement: Dimension, Tools of Performance Measurement, SCOR Model. Demand Chain Management, Global Supply Chain, Challenges in Establishing Global Supply Chain, Factors that influence Designing Global Supply Chain Network-case study.

Coordination in a Supply Chain: Importance of Coordination, Lack of Supply Chain Coordination and the Bull whip Effect, Obstacles to Coordination, Managerial Levels, Building Partnerships and Trust, Continuous Replenishment and Vendor Managed Inventories, Collaborative Planning, Forecasting and Replenishment. Role of Information Technology in Supply Chain, Supply Chain 4.0.-Case study.

4. Books and Materials

Text Books:

1. David B. Grant, Chee Yew Wong, Sustainable Logistics and Supply Chain Management: Principles and Practices for Sustainable Operations and Management, Kindle Edition
2. Fundamentals ofLogistics Management (The Irwin/Mcgraw-Hill Series in Marketing), Douglas Lambert, James R Stock, LisaM. Ellram, McGrawhill/Irwin, First Edition, 1998.
3. Vinod V. Sople (2009) Logistic Management (2nd Edn.), Pearson Limited.

Reference Books:

1. IMT Ghaziabad, Advanced Supply Chain Management Sage Publications, 2021.
2. Rajat K. Basiya, Integrated Supply Chain Management, Sage Publications, 2020.
3. K Sridhara Bhat, Logistics & Supply Chain Management, HPH,1e,2017.
4. Chopra, Sunil, Meindl, Peter and Kalra, D.V., Supply Chain Management: Strategy, Planning and Operation, Pearson Education,6e,2016.
5. Altekar, Rahul V, Supply Chain Management: Concepts and Cases, PHILearning,1e,2005.
6. Ballou, R.H. Business Logistics Management.Pearson Education,5e, 2014.
7. Coyle, Bardi, Langley, The Management of Business Logistics–A Supply Chain Perspective, Thomson Press,7e,2003.

Course Structure

A8086 - Management Science

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

In this course, students will learn the fundamental concepts and contributions of Management. It also explains Inventory control techniques, Human Resource Practices, Quality control techniques and Project Management which plays a vital role in the organization.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8086.1 Explain and infer the concepts and aspects of management.
A8086.2 Analyze the contributions of management, organizational structures, plant layouts, work study tools for enhancement of productivity in an organization
A8086.3 Apply the project management techniques to decide the optimum time and cost for completion of a project.
A8086.4 Apply statistical quality control & Inventory control techniques to manage and control products and materials.
A8086.5 Use Human resource management techniques for better people management.

3. Course Syllabus

Introduction: Management - Definition, Nature, Importance of management, Functions of Management- Taylor's scientific management theory, Fayol's principles of management, Contribution of Elton mayo, Maslow, Herzberg, Douglas MC Gregor. Basic concepts of Organisation Authority, Responsibility, Delegation of Authority, Span of control, Departmentation and Decentralization - Organisation structures (Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization).

Operations Management: Plant location, Factors influencing location, Principles and types of plant layouts - Methods of production (job, batch and mass production), Work study - Basic procedure involved in method study and Work measurement.

Quality Control and Materials Management: : Statistical quality control - Meaning-Variables and attributes - X chart, R Chart, C Chart, P Chart, (simple Problems) Acceptance sampling, Sampling plans, Deming's contribution to quality. Materials management - objectives, Need for inventory control, Purchase procedure, Store records, EOQ, ABC analysis, Stock levels.

Human Resource Management (HRM): Concepts of HRM, Basic functions of HR manager: Man power planning, Recruitment, Selection, Training and development, Placement, Wage and salary administration, Promotion, Transfers, Separation, performance appraisal, Job evaluation and Merit rating.

Project Management: Early techniques in project management - Network analysis: Programme evaluation and review technique (PERT), Critical path method (CPM), Identifying critical path, Probability of completing project within given time, Project cost analysis, project crashing (simple problems)..

4. Books and Materials

Text Books:

1. Koontz & weihrich - Essentials of management, TMH, 8th edition, 2010
2. O.P. Khana, Industrial engineering and Management, Dhanpat rai publication

Reference Books:

1. Dr.A.R.Aryasri, Management Science, TMH, 4th edition, 2009.
2. Stoner,Freeman, Gilbert, Management, 6th edition Pearson education, New Delhi, 2004
3. L.S.Srinath, PERT & CPM, 3rd edition East-West press pvt. ltd.-New Delhi.

Course Structure

A8087 - Human Resource Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is intended to disseminate the concepts of Human resource management, functions of Human resource management from human resource planning to employee relations aspects that helps in effective functioning of an organization.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8087.1. Identify the functions of Human Resource Management.
A8087.2. Illustrate the process of Recruitment and selection.
A8087.3. Analyse the needs and methods of training.
A8087.4. Appraise the functional relationship with performance compensation and employee welfare.
A8087.5. Examine the significance of employee relations.

3. Course Syllabus

Introduction to HRM: Objectives and Functions of HRM, Challenges of HRM, Line Managers. HR Roles and responsibilities, Workforce and demographic trends, New Approaches to organizing HR, HR Scorecard - Human Resource Information System (HRIS).

Recruitment and Selection: Job Design, Job Analysis, Process and methods of data collection, Job descriptions and Job specification, Job enlargement, Job enrichment and Job rotation. Human Resource Planning, Recruitment, Sources of Recruitment, Recruitment on Diverse Work Force, e-Recruitment and Selection Process, Employee Testing and Selection, Basic Types of Interviews, Errors in Interviews.

Training and Development: Definition, Training vs. Development, Importance of Training and Development, Process of Training, Methods of Training and Management development programmes. PERFORMANCE APPRAISAL: Concepts of Performance Management, Process of Performance Management, Performance Appraisal, Techniques of Performance Appraisal, Errors in Performance Appraisal, Career Management.

Compensation: Objectives of compensation, Factors influencing on compensation, concept of job evaluation and techniques of job evaluation. EMPLOYEE WELFARE: Concept of employee welfare, performance-based pay benefits, provisions of employee's compensation

act and implications of employee welfare on productivity.

Employee Relations: Employee Associations, Grievances: Grievances Handling Procedure, Employee Separation, Downsizing, Work-Life Integration - Hybrid work culture, contemporary developments in HR practices. Stress Management, talent mobility, Prevention of sexual harassment (POSH) at workplace.

4. Books and Materials

Text Books:

1. Gary Dessler, BijuVarkkey, Human Resource Management, 4th edition, Pearson Publication, 2017.
2. P. Subba Rao, Essentials of Human Resource Management, Himalaya Publishing, 6e, 2021.

Reference Books:

1. Biswajeet Pattanayak, Human Resource Management, 6e, PHI Learning Pvt. Ltd, 2020.
2. Mamoria and Mamoria, Personnel Management, Himalaya Publications, 2006

Course Structure

A8088 – Organizational Behavior

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	45	0	3	40	60	100

1. Course Description

Course Overview

The course focuses upon translation of organizational behaviour theory to practices that result in organizational effectiveness, efficiency, and human resource development. The primary goal of this course is to prepare students for advanced leadership roles in modern organization.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8088.1. Analyse the Concepts and models of Orgnizational Behaviour and Contemporary challenges.
A8088.2. Analyse the relevance of planning and decision making process for the development of the organisation.
A8088.3. Identify various organisation design and control technique for better performance of the company.
A8088.4. Examine the relevance of Individual and group behaviour in an organization and the role of Culture and dynamics
A8088.5. Apply the theories of leadership and motivation to lead people to attain the organisation goals.

3. Course Syllabus

Behavioural Concepts: Nature and Concepts of Orgnizational Behaviour, Models of Organizational Behaviour, Relationship with Other Fields, Contemporary challenges. Learning: Nature and Significance of Learning, Process of Learning, Theories of Learning.

Planning and Decision Making: Planning and Goal Setting, Organizational Planning, Vision, Mission and Goals, Types of Plans, Steps in Planning Process, Approaches to Planning, Planning in Dynamic Environment. Decision-making Process, Types of Decisions, Decision Making Styles, Vroom's Participative Decision-making Model.

Organizing and Controlling: Organizational Structure, Principles of Organizing, Authority, Power and Influence, Designing Organizational Structure. Mechanistic and Organic Structures, Contemporary Organizational Design and its Challenges. Controlling: The Control Process, Controlling for Organizational Performance, Types of Control, Financial Controls, Balanced Scorecard, Bench Marking, Contemporary issues in Controlling.

Organizational Behavior: Individual and Group Behavior: Importance of Organizational Behavior, Culture and Dynamics of Diversity, Personality Theories, Perception, Formation of Group Behavior, Classification of Groups, Group Properties, Group Cohesiveness, Building Teams.

Leadership and Motivation: Leadership Traits, Leadership Styles, Leadership Theories, Power and Politics. Motivation: Approaches to Motivation, Maslow's Needs Hierarchy Theory, Two-factor Theory of Motivation, McGregor's Theory, ERG theory, McClelland's Needs Theory, Valance Theory.

4. Books and Materials

Text Books:

1. K. Aswathappa, Organisational Behaviour, Himalaya Publications, 8e, 2021
2. Harold Koontz, Heinz Weihrich, Mark V Cannice, Essentials of Management, Tata McGraw Hill Education, 11e, 2020.
3. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behaviour, Pearson Education, 18e, 2018.

Reference Books:

1. Luthans Fred, "Organizational Behaviour", Tata McGraw Hill.
2. Rao V S P., "Organizational Behaviour", Excel Books.
3. Chandrani Singh, Aditi Ktri, Principles and Practices of Management and Organizational Behaviour, Sage Publications, 1e,2016.
4. Afsaneh Nahavandi, Robert B. Denhardt, Janet V. Denhardt, Maris P. Aristigueta, Organizational Behaviour, Sage Publications, 1e, 2015.

Course Structure

A8089 – Intellectual Property Rights

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	45	0	3	40	60	100

1. Course Description

Course Overview

This Course deals with the types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights. It analyzes and evaluates the procedures involved in submission of application for the grant of intellectual property rights. It also deals with the significance of intellectual property of a business enterprise.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8089.1. Identify the different types of intellectual property, agencies and treaties that protect intellectual property rights
A8089.2. Classify the protectable matter of intellectual property rights.
A8089.3. Analyze and evaluate the procedures involved in submission of application for the grant of intellectual property rights
A8089.4. Interprete Trade secret law, liability for misappropriations of trade secrets, protection for submission, and trade secret litigation

3. Course Syllabus

Introduction to Intellectual Property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Trade Marks: Purpose and function of trademarks, Trade mark rights, protectable matter, selecting and evaluating trademarks, trade mark registration process.

Law of Copy Rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of Patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Trade Secrets: Trade secret law, determination of trade secrets status, liability for misappropriations of trade secrets, protection for submission, and trade secret litigation.Unfair Competition: Misappropriation right of publicity, false advertising.

4. Books and Materials

Text Books:

1. R.S.Nagarajan, a Textbook on Professional Ethics and Human Values, New Age Publishers – 2006. Deborah.
2. Neeraj Pandey, Khushdeep Dharni- 2014, Intellectual property rights, PHI, India.

Reference Books:

1. Prabudda ganguli (2003), Intellectual property right, Tata McGraw Hill Publishing company ltd., India.
2. P.N. Cheremisinoff, R.P. Ouellette and R.M. Bartholomew, Biotechnology Applications and Research, Technomic Publishing Co., Inc. USA, 1985
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010

Course Structure

A8090 - Professional Practice, Law and Ethics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course makes students to understand the types of roles they are expected to play in the society as practitioners of an engineering profession. It develops ideas of the legal and practical aspects of their profession. Students will learn importance of professional practice, Law and Ethics in their personal lives and professional careers and the rights and responsibilities as an employee and team leader.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8090.1. Apply the concepts of professional practice, Law and Ethics in their personal lives and professional careers.
A8090.2. Analyze Arbitration, Conciliation and Alternative Dispute Resolution system
A8090.3. Interpret Law relating to Intellectual property
A8090.4. Apply the rights and responsibilities as an employee, team member in any organization as a global citizen.

3. Course Syllabus

Professional Practice and Ethics: Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Introduction to GST- Various Roles of Various Stake holders.

Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and discharge of Contracts, Remedies for breach of contract. Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996;UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention;

International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

Engagement of Labour and Labour & other construction-related Laws: Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other - Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017.

Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970.

4. Books and Materials

Text Books:

1. R. Subramanian - Professional Ethics, Oxford University Press, 2015.
2. Ravinder Kaur - Legal Aspects of Business, 4th edition, Cengage Learning, 2016.

Reference Books:

1. RERA Act, 2017.
2. Wadhera - Intellectual Property Rights, Universal Law Publishing Co.,2004.
3. 3. T. Ramappa - Intellectual Property Rights Law in India, Asia Law House,2010.
4. 4. O.P. Malhotra - Law of Industrial Disputes, N.M. Tripathi Publishers.

Course Structure

A8091 - National Cadet Corps(NCC)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

National Cadet Corps, is a unique course designed for youth in India that aims to develop character, discipline, leadership, secular outlook, spirit of adventure, and ideals of selfless service among young citizens. Through this course students learn about rhe national integration and its importance. They understand the concept of self-awareness and emotional intelligence, critical & creative thinking, decision making & problem solving and importance of Social service.This course also explores the security challenges & role of cadets in border areas. Students acquire the knowledge about various wars and their heroes.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

After the completion of the course, the student will be able to:

A8091.1. Acquire knowledge of the history of NCC, its organization, and incentives of NCC for their career prospects and duties & conduct of ncc cadets.

A8091.2. Imbibe good leadership traits and apply them in practical life and appreciate the visible outcome of leadership and motivation.

A8091.3. Develop a sense of responsibility, smartness in appearance and improve self-confidence, inculcate importance of empathizing with others, improve their deep-thinking ability and apply ideas and be able to face problems in a constructive manner with solutions.

A8091.4. Learn about the various natural resources, their utilization and practice method of conservation of these resources in daily life.

A8091.5. Appreciate value of physical and mental health in daily life and spread awareness about treatment and care of wounds in their society.

A8091.6. Understand individaul responsibilities & role in meetings the security challenges on Border/Coastal areas.

3. Course Syllabus

Introduction to NCC and National Integration: Introduction of NCC, History, Aims, Objective of NCC & NCC as Organization, Duties of NCC Cadet. National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building.

Personality Development & Leadership: Intra & Interpersonal skills - Self-Awareness- & Analysis, Empathy, Critical & creative thinking, Decision making and problem solv-

ing. levels of Creativity, Characteristics of creative person. Leadership capsule., Important Leadership traits, Indicators of leadership and evaluation., Motivation- Meaning & concept, Types of motivation. Factors affecting motivation., Ethics and Honor codes.

Social Service & Community Development: Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of Children & Women Safety., Road/Rail Safety., New Government Initiatives., Cyber and mobile Security Awareness.

Environmental Awareness and Conservation: Natural Resources, Conservation and Management, Water Conservation, Waste Management, Energy Conservation. Adventure Environmental Awareness and Conservation. Health & Hygiene: Hygiene & Sanitation (Hygiene- Personal & Social Hygiene)., First Aid in common medical emergencies. Treatment & Care of Wounds.

Border & Coastal Areas: History, Geography & Topography of Border/ Coastal Areas. Security Setup and Border/Coastal management in the area., Security Challenges & Role of cadets in Border management.

4. Books and Materials

Text Books:

1. R. K. Gupta, "Hand book of NCC Cadets for A, B & C Certificate Examinations", R-1992, 23rd Edition. Ramesh Publishing House, New Delhi (2023).