COURSE BOOK
CIVIL ENGINEERING DEPARTMENT
2019-20

G. H. RAISONI COLLEGE OF ENGINEERING, NAGPUR
(An Autonomous Institution affiliated to RTM Nagpur University, Nagpur)
CRPF Gate No.3, Digdoh Hills, Hingna Road, Nagpur-440 016.
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G. H. RAISONI COLLEGE OF ENGINEERING
Nagpur

Engineering   Management   Law   Schools   Other Courses
■ NAGPUR ■ PUNE ■ JALGAON ■ AMRAVATI ■ AHMEDNAGAR ■ CHHINDWARA

RAISONI
GROUP OF INSTITUTIONS

G H RAISONI COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)
Accredited by NAAC with 'A+' Grade
CRPF Gate No.3, Hingna Road, Digdoh Hills, Nagpur – 440 016. (INDIA)
Phone : +91 9604787184, 9689903286, 9921008391   Fax : +91 – 7104 – 232560
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GHRCE/HoD/Dept./Scheme/UG/PG/02/01/02

Note: Applicable from 2018-19

VISION & MISSION OF INSTITUTE

VISION
To achieve excellent standards of quality education by keeping pace with rapidly changing technologies and to create technical manpower of global standards with capabilities of accepting new challenges

MISSION
Our efforts are dedicated to impart quality and value based education to raise satisfaction level of all stake-holders. Our strength is directed to create competent professionals. Our endeavour is to provide all possible support to promote research and development activities

Programme: UG in Civil Engineering

CIVIL ENGINEERING PROGRAM

VISION

To achieve excellent standards of quality education in Civil Engineering by keeping pace with rapidly changing technologies & to create technical manpower of Global Standards in Civil Engineering with capabilities of accepting new challenges.

MISSION
1. To impart quality and value based education to raise satisfaction of all stake holders.
2. To serve society and nation for providing professional leadership in Civil Engineering for solving the problems consistent with rapidly changing technologies.
3. To create competent Civil Engineering professionals who are trained in the design and implementation of Civil Engineering systems.
4. To promote Research & Development Activities in the field of Civil Engineering and allied areas.

Programme Educational Objectives (PEOs)

The programme educational objectives of the civil engineering program are designed to produce skilled engineers who are ready to contribute effectively to the advancement of civil engineering profession and are ready to handle the challenges of the profession. They shall be able to:

1. **(PEO1)** Apply fundamental technical knowledge and skills to find creative solutions to technological challenges and problems in various domains of Civil Engineering.

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2. **(PEO2)** Analyze, design and use skills in order to formulate and solve Civil Engineering problems.
3. **(PEO3)** Practice Civil Engineering in an ethical manner, as an individual or a team member, implementing eco- friendly sustainable technologies.
4. **(PEO4)** Take up higher education and R & D in civil engineering and allied areas of science and technology for the benefit of industry and society.

PROGRAM OUTCOMES (Pos):-

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.

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

3. **Design/development of solutions**: Design solutions for complex engineering problems anddesign 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.

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

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

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

7. **Environment and sustainability**: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.

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

10. **Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity 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.

11. **Project management and finance**: Demonstrate knowledge and understanding of theengineering 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.

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

PROGRAM SPECIFIC OUTCOMES (PSO's)
A graduate of the Civil Engineering Program will demonstrate:

PSO1:Understanding: Graduates will have an ability to describe, analyze, and solve problems in the core & allied areas of civil engineering

PSO2:Analytical Skills: Graduates will have an ability to conduct investigation of problems to design a system, component, or process using modern tools in accordance with National and ASCE codes**.**

PSO3:Broadness: Graduate shall be able to engage in lifelong learning and participate in serving the society as a member or leader of diverse team to provide civil engineering solutions in a global, economic and societal context.

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Summery Civil Engineering

Branch	Sem	Credits	Th_HDS	Pr_HDS	Contact Hrs	Th_Int	Th_ESE	Pr_Int	Pr_Ext	Total Marks
CIV	1	21	8	8	29	200	175	225	0	600
CIV	2	22	4	10	35	150	100	350	0	600
CIV	3	19	8	6	24	200	200	125	50	575
CIV	4	22	7	9	31	175	175	175	100	625
CIV	5	20	7	7	26	175	175	225	0	575
CIV	6	19	7	9	26	175	175	225	25	600
CIV	7	19	7	2	20	175	175	75	50	475
CIV	8	18	1	2	18	25	25	150	250	450
TOTAL		160	49	53	209	1275	1200	1550	475	4500

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B.E. FIRST YEAR SCHEME (CIVIL ENGINEERING 2018-19)

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme				Total Marks
							Theory			Practical	
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Cont	
SEMESTER-I											
BFYL101	Matrices	1	1	-	2	2	10	15	25	--	50
BFYL102	Differential & Vector Calculus	1	1	-	2	2	10	15	25	--	50
BEEL101 BEEP101	AC & DC Circuits	1	-	2	3	2	10	15	25	25	75
BEEL102	AC & DC Machine	2	-	-	2	2	10	15	25	--	50
BEEL103	Energy Sources & Audit	1		-	1	1	10	15	--	--	25
BITL101 BITP101	Programming for Problem Solving	1	-	4	5	3	10	15	25	50	100
BECL104	Bio-System in Engineering	1	1	-	2	2	10	15	25	--	50
BCSP101	Data Analytics	-	-	2	2	1	--	--	--	25	25
BECL101 BECP101	Introduction to Digital System	1	1	2	4	3	10	15	25	25	75
BHUP103	Foreign Language	-	-	2	2	1	--	--	--	25	25
BHUP104	Liberal/ Creative Arts	-	-	1	1	0.5	--	--	--	25	25
BFYP131	Waste Management	-	-	2	2	1	--	--	--	25	25
BFYP132	Environmental Science	-	-	1	1	0.5	--	--	--	25	25
TOTAL		**9**	**4**	**16**	**29**	**21**	**80**	**120**	**175**	**225**	**600**

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme				Total Marks
							Theory			Practical	
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Cont.	
SEMESTER-II											
BFYL103	Integral & Multiple Calculus	1	1	-	2	2	10	15	25	--	50
BFYL104	Ordinary & Partial Differential Equations	1	-	-	1	1	10	15	25	--	50
BCSP102	Data Structure	-	-	4	4	2	--	--	--	50	50
BFYP152	Internet of Things	-	-	2	2	1	--	--	--	25	25
BFYL121 BFYP121	Applied Physics	1	1	2	4	3	10	15	25	25	75
BCEL101 BCEP101	Engineering Mechanics	1	1	2	4	3	20	30	--	25	75
BECP103	Embedded Programming	-	-	2	2	1	--	--	--	25	25
BMEP102	Digital Fabrication	-	-	4	4	2	--	--	--	50	50
BFYP151	Mini Model through Innovation & Creativity	-	-	4	4	2	--	--	--	50	50
BHUL101 BHUP101	Communication Skills	-	2	2	4	3	10	15	25	50	100
BHUP102	Ethics& Professional Competencies	-	-	2	2	1	--	--	--	25	25
BMBP101	Entrepreneurship	-	-	2	2	1	--	--	--	25	25
TOTAL		**4**	**5**	**26**	**35**	**22**	**60**	**90**	**100**	**350**	**600**

B.E. SCHEME (CIVIL ENGINEERING)

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					Total	Mode of Exam
							Theory			Practical			
		Th	Tu	Pr	Total		TAE	CAE	ESE	Int.	Ext.		
TERM – III													
BFYL108	Maths 5 (FS and PDE)	1	1	0	2	2	10	15	25	-	-	50	
BHUP203	Quant	0	0	1	1	0.5	-	-		25	-	25	
BHUP202	Reasoning	0	0	1	1	0.5	-	-		25	-	25	
BCEP233	Skill Development 1 (Linear Algebra)	0	0	2	2	1	-	-		25	-	25	
BCEL221	Materials, Testing & Evaluation	2	0	2	4	3	10	15	25	25	25	100	Offline
BCEL222	Mechanics of materials	1	1	0	2	2	10	15	25	-	-	50	Offline
BCEL223	Soil Mechanics	2	0	2	4	3	10	15	25	-	25	75	Offline
BCEL224	Fluid Mechanics	1	0	2	3	2	10	15	25	25	-	75	Offline
BCEL225	Hydrology & Water resource Engineering	2	0	0	2	2	10	15	25	-	-	50	Online Case Study
BCEL226	Instrumentation & Sensor Technologies for Civil Engineering Applications	1	-	-	1	1	10	15	25	-	-	50	Online Hacka-thon
BCEL227	Basics of Transportation & Introduction to ITS	2	-	-	2	2	10	15	25	-	-	50	Offline
	TOTAL	**12**	**2**	**10**	**24**	**19**	**80**	**120**	**200**	**125**	**50**	**575**	

B.E. SCHEME (CIVIL ENGINEERING)

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					Total	Mode of Exam
							Theory			Practical			
		Th	Tu	Pr	Total		TAE	CAE	ESE	Int.	Ext.		
TERM – IV													
BFYL109	Maths 6 (Numerical Methods)	2	0	0	2	2	10	15	25	-	-	50	
BCSL220	AI &Machine Learning	2	0	0	2	2	10	15	25	-	-	50	
BHUP206	Aptitude 1	0	0	1	1	0.5		-	-	25	-	25	
BAIL101	Open Elective-I (Artificial Intelligence & its Application)	2	0	0	2	2	10	15	25	-	-	50	
BHUP205	BEC	0	0	4	4	2				50		50	
BMBP201	EDP	0	0	2	2	1	-	-	-	25	-	25	
BCEP234	Skill Development 2(Autocad,3d max)	0	0	2	2	1	-	-	-	25	-	25	
BCEL228	Concrete Technology	2	0	2	4	3	10	15	25		25	75	Offline
BCEP229	Architectural Planning & Drawing	-	-	2	2	1	-	-	-	25	25	50	Online on Auto-CAD
BHUP204	Liberal Arts / Creative Arts (Hobby Module)	0	0	1	1	0.5		-	-	25	-	25	
BCEL230	Surveying & Geomatics	2	0	2	4	3	10	15	25	-	25	75	Offline
BCEL231	Environmental Engineering	1	0	2	3	2	10	15	25	-	25	75	Online Case Study
BCEL232	Structural Analysis	1	1	-	2	2	10	15	25	-	-	50	Offline
	TOTAL	**12**	**01**	**18**	**31**	**22**	**70**	**105**	**175**	**175**	**100**	**625**	

B.E. SCHEME (CIVIL ENGINEERING)

Sub. Code	Name of the Course	Th	Tu	Pr	Total	Credits	TAE	CAE	ESE	Int.	Ext.	Total	Mode of Exam
								Theory		Practical			
TERM – V													
BFYL110	Maths 7 (Higher Order Matrices & Probability)	1	0	0	1	1	10	15	25	-	-	50	
BHUP301	Advanced Communication Skills (Voice Versant &Essay)	0	0	4	4	2				50	-	50	
BCEP324	Skill Development 3 (PRIMAVERA)	0	0	2	2	1	-	-	-	25	-	25	
BCEP325	Internship (Social + Minor Project + Teaching Report Writing)	0	0	2	2	2	-	-	-	50	-	50	
BHUP302	Aptitude 2	0	0	1	1	0.5	-	-	-	25	-	25	
	Elective-I (Engg. Science)	2	0	0	2	2	10	15	25	-	-	50	
	Elective-II (Humanities)	2	0	0	2	2	10	15	25	-	-	50	
BCEL331	Irrigation and Drainage Engineering	1		0	1	1	10	15	25	-	-	50	Online Case Study
BCEL332	Reinforced Concrete Design	2	-	2	4	3	10	15	25	25	-	75	Offline
BCEP333	Building Services	-	-	1	1	0.5	-	-	-	25	-	25	Online Case Study
BCEL334	Foundation Engineering	2	-	2	4	3	10	15	25	25	-	75	Offline
BCEL335	Disaster Preparedness & Planning	2	-	-	2	2	10	15	25			50	Offline
	TOTAL	**12**	**0**	**14**	**26**	**20**	**70**	**105**	**175**	**225**	**0**	**575**	

B.E. SCHEME (CIVIL ENGINEERING)

Sub. Code	Name of the Course	Th	Tu	Pr	Total	Credits	TAE	CAE	ESE	Int.	Ext.	Total	Mode of Exam
								Theory		Practical			
TERM – VI													
BFYL111	Maths 8 (Optimization & Calculus of variation)	1	0	0	1	1	10	15	25	-	-	50	
BMEP319	Product Development & IPR	0	0	1	1	0.5	-	-	25	-	25		
BCEP326	Skill Development 4 (Analysis & Design Software)	0	0	2	2	1	-	-	-	25	-	25	
BCEP327	Skill Development 5 (Env. Audit & Excel)	0	0	2	2	1	-	-	-	25	-	25	
MBAP315	Financial Management for Engineers	0	0	1	1	0.5	-	-	-	25	-	25	
BHUP207	Soft Employability Skill	0	0	1	1	0.5				25		25	
BHUP303	Aptitude 3	0	0	1	1	0.5	-	-	-	25	-	25	
BCEL340	Elective-III (Building Information Modeling (BIM)	1	0	2	3	2	10	15	25	25	-	75	Online Software Based
xxx	Open Elective-II	2	0	0	2	2	10	15	25	-	-	50	
BCEL336	Design of Steel Structures	2	0	2	4	3	10	15	25	25	-	75	Offline
BCEL337	Engineering Economics, Estimation & Costing	2	0	2	4	3	10	15	25	25	25	100	Offline
BCEL338	Advanced Structures Analysis	1	1	0	2	2	10	15	25	-	-	50	Offline
BCEL339	Project Planning Construction Management	2	0	0	2	2	10	15	25	-	-	50	Online Case Study
	TOTAL	**11**	**1**	**14**	**26**	**19**	**70**	**105**	**175**	**225**	**25**	**600**	

B.E. SCHEME (CIVIL ENGINEERING)

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					Total	Mode of Exam
		Th	Tu	Pr	Total		Theory			Practical			
							TAE	CAE	ESE	Int.	Ext.		
TERM – VII													
BCELxxx	Department Elective-IV	2	0	0	2	2	10	15	25	-	-	50	Offline
BCELxxx	Department Elective-V	2	0	0	2	2	10	15	25	-	-	50	Offline
BCELxxx	Department Elective-VI	2	0	0	2	2	10	15	25	-	-	50	Offline
BCELxxx	Department Elective-VII	2	0	0	2	2	10	15	25	-	-	50	Offline
BCELxxx	Department Elective-VIII	2	0	0	2	2	10	15	25	-	-	50	Offline
BCELxxx	Department Elective-IX	2	0	0	2	2	10	15	25	-	-	50	Offline
BCELxxx	Department Elective-X	2	0	0	2	2	10	15	25	-	-	50	Offline
BCEP441	Project (Phase-I)	0	0	4	4	4				50	50	100	
BHUP304	Carrer Development Practices	0	0	2	2	1				25		25	
	TOTAL	**14**	**0**	**6**	**20**	**19**	**70**	**105**	**175**	**75**	**50**	**475**	

B.E. SCHEME (CIVIL ENGINEERING)

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					Total	Mode of Exam
		Th.	Tu.	Pr.	Total		Theory			Practical			
							TAE	CAE	ESE	Int.	Ext.		
TERM – VIII													
BCEP442	6 Months Internship / Field Project	0	0	12	12	12	0	0	0	100	200	300	Offline
	Open Elective –III (Moocs)	2	0	0	2	2	10	15	25	0	0	50	Offline
BCEP443	Project (Phase-II)	0	0	4	4	4	0	0	0	50	50	100	Offline
	TOTAL	**2**	**0**	**16**	**18**	**18**	**10**	**15**	**25**	**150**	**250**	**450**	
	TOTAL (3 TO 8)	**63**	**4**	**78**	**145**	**117**	**370**	**555**	**925**	**975**	**475**	**3300**	
	TOTAL (1 TO2)	**13**	**9**	**42**	**64**	**43**	**140**	**210**	**275**	**575**	**-**	**1200**	
	TOTAL (1 TO 8)	**76**	**13**	**120**	**209**	**160**	**510**	**765**	**1200**	**1550**	**475**	**4500**	

The Civil Engineering Syllabus offers Electives Specializations within the field of Civil Engineering

BCEL401.	Advanced Structural Design	BCEL417.	Advanced Transportation Engineering
BCEL402.	Advance Concrete Design	BCEL418.	Urban Transportation Planning
BCEL403.	Earthquake Resistant Structures	BCEL419.	Advanced Surveying
BCEL404.	Advanced Steel Design	BCEL420.	Remote Sensing & Gis
BCEL405.	Matrix Method Of Structural Analysis	BCEL421.	Operation Research & Management
BCEL406.	Repair and Rehabilitation of Structures	BCEL422.	New Engineering Materials & Techniques
BCEL407.	Environmental Management	BCEL423.	Earth and Earth Retaining Structure
BCEL408.	Waste Water Engineering	BCEL424.	Energy Conservation and Environment
BCEL409.	Green Building	BCEL425.	Introduction to Structural Dynamics
BCEL 410.	Air Pollution & Solid Waste Management	BCEL426.	Geology and Earth Science
BCEL411.	Municipal & Industrial Water Treatment	BCEL427.	Pre-Fabricated structure
BCEL412.	Advanced Fluid Mechanics	BCEL428.	Prestressd Concrete Structures
BCEL413.	Ground Water Management	BCEL429.	Bridge Engineering
BCEL414.	Advanced Hydraulics	BCEL430.	Forensic Civil Engineering
BCEL415.	Soil Dynamics	BCEL 431/ STRL405	Theory of Elasticity and Elastic Stability
BCEL416.	Pavement Design		

Energy Sources & Audit

Course Objectives:
1. To Study the various types of electrical sources
2. To study the comparisons of various sources.
3. To study the non-Conventional electrical sources

Course Outcome:
1. To understand present scenario of energy & its importance
2. To Learn Conventional energy sources &Non conventional Energy sources
3. To Understand concept of Energy Management
4. To apply knowledge of energy audit to industry
5. To understand importance of safety components

Contents:

Unit 1 Energy Sources

Current Energy Scenario,Conventional Energy Sources, Types of conventional energy sources, importance & drawbacks ofConventional Energy Sources, Alternatives to conventional energy sources.Non Conventional Energy Sources, Types of non-conventional energy sources, importance& drawbacks of Non-Conventional Energy Sources, Comparison with conventional energy sources & its application. **(4hrs)**

Unit 2 Energy Management & Audit

Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, energy audit instruments. **(4hrs)**

Unit 3: Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, types of Earthing systems.Power factor improvement. **(6hrs)**

Books:
1. Non-Conventional Energy Resources, B H Khan Tata McGraw-Hill Education, 01-Jan-2006
2. Non-conventional Energy Sources, G. D. Rai, Khanna Publisher
3. Handbook of Energy Audit, Sonal Desai
4. Energy Management, Audit & Conservation by Barun Kumar De,

PROGRAMMING FOR PROBLEM SOLVING

Course Objectives:
1. This Course introduces basic idea of how to solve given problem.
2. Focuses of paradigms of programming language.
3. Aims at learning python as programming language.

Course Outcomes:

Course Outcome
1. Analyze and understand the behavior of fundamental programming constructs.
2. Develop and Analyze Algorithms for solving problems.
3. Demonstrate the knowledge of various concepts of Python Language.
4. Develop solutions using functions & recursion
5. Demonstrate knowledge of Dictionaries.
6. Demonstrate knowledge of advanced concepts of python programming

Contents:

Algorithmic Problem Solving: Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). **(7hrs)**

Data, Expressions, Statements: Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments. **(10hrs)**

Control Flow, Functions: Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if, if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices. **(10hrs)**

Dictionaries: Operations and methods; advanced list processing – list comprehension. **(4hrs)**

Object Oriented Programming: Classes and objects-inheritance-polymorphism **(10hrs)**

Exception Handling & File Handling: Overview of exception classes and types: try, except. Finally, File processing: reading and Writing files. **(4hrs)**

Books:
1. Python Programming using Problem Solving Approach by ReemaThereja, Oxford Publication.
2. Python Programming: An Introduction to Computer Science 2nd Edition by John Zelle
3. Python Programming for the Absolute Beginner, 3rdEdition by Nicheal Dawson.

Data Structures

Course Objectives:
1. This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
2. It also aimed at developing skill to implement methods to solve specific problems using basic data structures.
3. The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.

Course Outcomes:
1. Identify essential data structures and understand when it is appropriate to use.

2. Explain use of Abstract data types & ways in which ADTs can be stored, accessed and manipulated.
3. Apply linear data structures to solve various real world computing problems using programming language.
4. Analyze standard algorithms for searching and sorting.

Contents:

Database Management System: Database Concepts –Introduction, Data, Information, Metadata, Components of Database Management system, SQL select statement, Operators, Data Types, Single Row Function, Aggregating Data, Using Group Function, Data Manipulation Statement, Data Definition Statement, Constraints. **(7hrs)**

Arrays & Pointers: Introduction, Linear Arrays, Arrays as ADT, Representation of Linear array in Memory, Traversing Linear Arrays, Inserting and deleting, Multidimensional Arrays, Pointers; Pointer Arrays, Dynamic Memory Management. **(7hrs)**

Linked List : Introduction, Linked Lists, Representation of Linked Lists in Memory, Traversing a Linked List, Searching a Linked List, Memory Allocation; Insertion into a Linked List, Deletion from a Linked List, Circularly Linked Lists, Two-Way Lists (or Doubly Linked Lists). **(8hrs)**

Stacks, Queue and Recursion : Introduction, Stacks, Array Representation of Stacks, Linked Representation of Stacks, Stack as ADT, Application of Stacks, Recursion, Queues as ADT, Types of Queues (Circular Queues, Dequeues), and Applications of Queues. **Sorting and Searching** Introduction: Sorting; Bubble Sort, Insertion Sort, Selection Sort, Searching; Linear Search, Binary Search. **(8hrs)**

Books:
1. Ivan Bayross ,'SQL, PL/SQL The programming language of Oracle
2. Data Structures with C, Seymour Lipschutz, Schaums Outlines, Tata McGraw Hill
3. Horowitz E. &Sahani S., 'Fundamentals of Computer Algorithms', Galgotia Publications Ltd
4. S. Sahani, Data Structures in C.
5. D. Samantha, Classic Data Structures, PHI Publications.

Data Analytics

Course Objective:
1. This course helps to understand data and usage of data in solving real time problems.
2. It introduces general idea of database management systems.
3. It also explains the fundamental concepts of big data analytics and data visualization.

Course Outcomes:
1. Understand data and usage of data in data analytics.

2. Apply data analytics techniques for visualization through Excel.
3. Analyze and design multidimensional data models.
4. Visualize trends and discover insights of data.
5. Derive Entity- Relationship (E-R) model from specifications and transform it into relational model.
6. To design SQL queries to perform CRUD operations on database (Create, Retrieve, Update, and Delete)

Contents:

Unit 01: Introduction to Data Analytics
Introduction, MS Excel Basics (options: Create, Save Rename, Add, Delete), Editing data in Worksheet (options: Insert, Select, Delete, Copy & Paste, Find & Replace) Formatting Cells, Worksheets (operations: Add/Remove Columns & Rows, Hiding/Unhiding Columns & Rows, Merging Cells), Setting Colors. **(2hrs)**

Unit 02: Manipulation of Excel Data
Working with Formula: Data Filtering, Sorting, Use of Range, Functions: SUM(), AVERAGE(), MAX() & MIN(), COUNT() & COUNTA(), IF(), Data Representation using Charts & Graphs, Creation of Pivot table, Create a Chart, Change Chart Type, Switch Row/Column, labels and legends, Print Area. **(6hrs)**

Unit 03: Basics of DBMS
Introduction, Characteristics, Data models (Entity-Relationship Model, Relational Model, Network model), Relational algebra. **(2hrs)**

Unit 04: Getting started with basic design templates
Multidimentional Models, Basic Design, Chart Generation, Dashboard Creation, Data Visualization. **(6hrs)**

Unit 05: Basics of Open Source RDBMS
Introduction, Installation, MySQL Commands (Administrative Commands), Various Syntax of SQL, DDL and DML Commands. **(4hrs)**

Books:
1. Microsoft Excel 2013 Step by Step by Curtis D. Frye; Microsoft Press 2013.
2. Database System Concepts, by Abraham Silberschatz, Professor, Henry F. Korth, and S. Sudarshan, 3RD Edition, Publisher: McGraw-Hill Education
3. Learning Tableau by Joshua N. Milligan,ISBN 139781784391164, PACKT Books - Packt Publishing

Urls:
1. https://www.guru99.com/excel-tutorials.html
2. https://www.tableau.com/
3. https://www.smartdraw.com/uml-diagram/
4. http://www.nptel.ac.in/courses/106104135/[For Fundamentals of Database Systems]

Engineering Graphics

Course Objectives:
1. To familiarize with basic engineering graphics principles and standards of drafting.
2. To use various engineering drawing techniques to create drawing of machine parts.

3. To understand and read drawings and blue prints for industrial applications.

Course Outcomes:
1. Apply various concepts like dimensioning, conventions and standards related to engineering graphics in order to become professionally efficient
2. Read and interpret drawings of simple machine parts in first and third angle of projection systems
3. Read and interpret projections of lines and planes along with traces
4. Visualize and project solid geometry in different positions
5. Visualize and project sections and development of solids in different positions
6. Translate the three dimensional engineering objects into two dimensional drawings and vice versa using drafting tools.

Contents:
Lettering, Dimensioning, Introduction to scale and curve: Use of various drawing instruments, lines, lettering and ISI standards for drafting. Simple geometrical construction. Definition of scale, Representative fraction, enlarging scale drawing ,reducing scale drawing and full size drawing, dimensioning, Introduction to basic Engineering curves (conic sections) **(2hrs)**
Theory of Projections: Theory, techniques, first and third angle projections, Projection of points. Projection of straight lines inclined to both reference planes. **(3hrs)**
Projection of Planes: Plane inclined to both reference planes. Auxiliary planes and view: Auxiliary vertical plane and Auxiliary inclined plane. **(2hrs)**
Projection of Solids: Projections of solids such as Prisms, pyramids, cone, cylinder with varying position of axes with ground line. **(2hrs)**
Sections of solids: Section of solid such as Prisms, pyramids, cone, cylinder **(2hrs)**
Development of solid surfaces: Development of surfaces for various regular solids. **(2hrs)**
Orthographic Projection and Isometric projection: Conversion of pictorial view of solid to orthographic views and isometric view. **(2hrs)**
Books:
1. Engineering Drawing, N. D. Bhatt, Panchal, Charotar Publishing House
2. Engineering Graphics, Venugopal K and Prabhu Raja V, New AGE International Publishers.
3. A text Bok of Engineering Graphics using AUTO CAD, Sarkar, Rastogi and Kulkarni, Tata McGraw Hill

Engineering Mechanics
Course Objectives:
1. To describe and be able to predict the conditions of rest or motion of the bodies under the action of forces.

2. To understand the basic concepts of forces moments, couples in two dimensional force system & spatial force system.
3. To be able to analyze simple determinate structures like beam & trusses

Course Outcomes:
1. Apply the concept of two dimensional force systems for replacement into equivalent force system
2. Understand the basic concepts of free body diagrams for static equilibrium for two dimensional force systems
3. Demonstrate the basic concepts of forces, moments, and couples in spatial force system.
4. Apply the basic concepts of Moment of inertia & Virtual Work

Contents:
Fundamentals of Statics: Definition of mechanics, Body, Rigid Body, Scalar quantities, Vector quantities, Representation of vector, Fundamental Units, Derived Units, Particle, Mass, Weight, Fundamental principles of mechanics, Newton's law of universal gravitation.
Equivalent Force System (2-D): Concept of Force, Unit Newton force, System of force, Principle of transmissibility of force, Resolution and composition of coplanar force system, Resultant, Equilibrant, Law of parallelogram of force, Triangle law, Polygon law, Moment of force, Varignon's theorem, Couple and it's properties, Reduction of system of forces into a force couple system. Numerical on equivalent force involving co-planer force systems acting on body, Numerical on reduction of system of forces into a force couple system. **(5 hrs)**
Equilibrium of Two Dimensional Force System: Concept of equilibrium, Principles of equilibrium, Equations of Equilibrium, Lami's theorem, Numerical on equilibrium involving co-planer force systems acting on body. **Beam**, Simply Supported Beam, Overhanging Beam, Beam reaction, Types of load acting over beam i.e. Concentrated load, Uniformly distribute load (UDL), Uniformly varying load (UVL), Types of support i.e. Simple support, Hinge support, Roller Support, Numerical on reaction of beam subjected to combination of loads.
Analysis of Truss: Perfect Frame, Imperfect frame, Deficient frame, Redundant frame, Assumptions made in analysis of truss, Method of joints, & sections, Numerical on forces in the members of a truss. **(10hrs)**
Spatial Force System (Three Dimensional Force System): Component of force in a space, Resultant spatial force system,Force multiplier, Cartesian form of representation of vector, Unit vector, Position vector, Displacement Vector, Scalar product or Dot product, Cross product, Length of common perpendicular between two non- intersecting vectors, Shortest

distance, Moment of force about point, Moment of force about axis, Moment arm of force about point, Moment arm of force about axis, Resultant moment, Couple,

Friction: Definition of friction, Types of friction, Angle of repose Coulombs laws of dry friction, Analysis of rigid bodies on rough inclined surfaces. **(8hrs)**

Properties of Areas: Centroid of plane areas, Moment of Inertia of composite lamina, Radius of gyration, Second moment of area, Product of inertia, Parallel axis theorem, Perpendicular axis theorem, Polar moment of inertia, Moment of inertia & product of inertia about new axes, Principal moment of inertia and principal axis direction by analytical method only. **(7hrs)**

Virtual Work: Virtual Displacement, Definition of virtual work, Principles of virtual work Virtual work method applied to beams & frames mechanisms.

Books:
1. K Vijaya Kumar Reddy & J Suresh Kumar, Singer's Engineering Mechanics , 3rd Edition, BS Publications, 2010
2. Beer F.P. and Johnston E.R., Vector Mechanics for Engineers: Statics and Dynamics, Tata McGraw-Hill, 9th edition 2012
3. Irving H. Shames, Engineering Mechanics: Static and Dynamics, Pearson Education, Asia Pvt Ltd, 4th edition 2009

Analog Circuit
Course Objectives:
1. To familiarize with various electronic components and understand their properties.
2. To understand basic fundamentals of analog circuits.
3. To prepare for various engineering applications.

Course Outcomes:
1. Use knowledge of diode for related application.
2. Demonstrate the knowledge of transistor and its application
3. Demonstrate the knowledge of oscillator
4. Use devices for designing of small electronics projects.

Contents:
Linear Circuits & Applications of Diodes: Clippers, Clampers, Limiters, AC to DC convertor, voltage regulator, low pass filter, high pass filter with characteristics. **(8hrs)**

Bipolar Junction Transistor and its applications:
Transistor action, BJT configurations: CE, CC, CB with normal biasing, DC load line, Single stage CE transistor as amplifier, Practical amplifier biasing, BJT as a switch. **(8hrs)**

Oscillator: LC Oscillator,RC Oscillator,Crystal oscillator using transistor, Need of Power Amplifier and difference between Voltage and Power Amplifier555 Timer: IC 555 pin Configuration and its applications. **(8hrs)**

Books:
1. Basic Electronics & Linear Circuits, (Late) N N. Bhargava, Tata McGraw Hill, 2013, Second Edition.
2. Electronic Devices & Circuits Theory, Robert L. Boylestad, Louis Nashelsky, Pearson India, 2009, 10th Edition.
3. Integrated Electronics, Jacob Millman, Tata Mcgraw-Hill, 2009, Second Edition.
4. Microelectronics Circuits, A.S. Sedra&K.C.Smith, Oxford University Press, 2013, Seventh Edition

Ethics & Professional Competency
Course Objectives:
1. To inculcate the highest level of ethical awareness and conduct among students. To make students ethically and socially aware and active
2. To have a critical reflection of one's personality thereby creating and developing professional competency.

Course Outcomes:
1. To demonstrate awareness regarding ethical issues in daily situations
2. To manage themselves easily in the dynamic environment.

Contents:
Orientation & SWOT Analysis, Plagiarism, Movie analysis, Movie analysis, AajKiAdalat (Panel Discussion) Goal Setting & Time management, Goal Setting & Time management, Thinking hats, 6 Thinking hats, Telephone etiquettes, Leadership & Team work, Time management. **(15hrs)**

Books:
1. Success Never Ends, Failure is Never Final, Robert Schuller, Paperback, 1990, Revised,
2. Body Language, b Allen Pease, Paperback, 2005, First

Liberal / Creative Arts
Course Objectives:
1. The Students shall be given exposure on various musical instruments like Guitar, Sitar, and Piano etc. according to their interest.
2. To inculcate healthy life style in students.
3. To impart discipline in students.
4. The students will be given exposure on Indian Classical music. It is aimed at a close interaction between students, artistes and craftsmen.
5. The students will be offered a Film & television Workshop for hands on experience on interactive learning.

Course Outcomes:
1. Play various musical instruments of their interest.
2. Understand and emphasize importance of good health in life
3. Be in self-discipline.

4. Apply the interactive learning experience in the diverse arts.

Contents:

Musical Instruments, Power Yoga/ Pranayam, National Credit Corp, Spic Macay, Film & Television
(13hrs)

Foreign Languages
FRENCH:

Course Objectives:

1. Written communication: student can create basic-level French written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.

2. Oral communication: student can create basic-level French oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.

Course Outcomes:

1. Exchange basic greetings in the socialcontext.
2. Respond to classroom directions and basic commands.
3. Express basic needs in day-to-daylife.
4. Provide and acquire basic personal and social information.
5. Read and write all characters and compound characters.
6. Form and understand sentences consisting of basic grammar patterns and particles.
7. Count and understand basic numbers.
8. Ask and understand the prices of commodities in stores, as well as purchase them.

Contents:

Introduction to France – its culture and people, Pronunciation and basic greetings, Grammar- Nouns-genders, article Vocabulary- Months, weekdays and daytimes and number system Vocabulary-Time and date Grammar- Auxiliary verbs (Avoiretre), Vocabulary-colors, Vocabulary-Family, profession Vocabulary- Directions, Common words
Test (30 min), Listening to CD, Vocabulary- House and Furniture and DraperiesVocabulary- Food and Drink and CutleryGrammar-Regular, verbs Vocabulary-Vegetables and fruits. Grammar-Irregular verbs Grammar-Modal verbs Listening to CDS ….Vocabulary- Body parts and ClothesTranslation passage and spoken Test (30 min), Listening to CDTranslation passage and spokenGrammar-Imperative sentences and Framing questionsVocabulary- School and college and stationary Grammar- cases in FrenchVocabulary-Modes of transport, Random vocabularyGrammar-cases in FrenchTest (30 min) , Listening to CDTranslation passage Writing emails …Resume building Listening and speaking sessionsTest.
(60 min)(15hrs)

GERMAN:

Course Objectives:

1. Written communication: student can create basic-level German written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.

2. Oral communication: student can create basic-level German oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.

Course Outcomes:

1. Exchange basic greetings in the social context.
2. Respond to classroom directions and basic commands.
3. Express basic needs in day-to-day life.
4. Provide and acquire basic personal and social information.
5. Read and write all characters and compound characters.
6. Form and understand sentences consisting of basic grammar patterns and particles.
7. Count and understand basic numbers.
8. Ask and understand the prices of commodities in stores, as well as purchase them.

Contents:

Introduction to Germany – its culture and peoplePronunciation – BASIC and ADVANCED Basic Greetings and Self-IntroductionGrammar- Nouns-genders, article Grammar- Nouns - Plural forms Vocabulary- Months, weekdays and daytimes and number system Vocabulary-Time and date Grammar – Personal PronounsVocabulary-Family, professionsVocabulary- Directions, Common wordsVocabulary –Job-Related and Modes Of TransportGrammar – Possessive PronounsVocabulary- House, Furniture and DraperiesVocabulary- Food and DrinksGrammar-Regular verbs Vocabulary- Vegetables and fruitsGrammar-Irregular verbs Grammar-Modal verbs and Imperative Verbs WH – QuestionsVocabulary-Body parts and ClothesGrammar – Sentences- types and Framing. Grammar-Imperative sentences and Framing questionsVocabulary-Common Places and Hobbies
Grammar- Adjectives and Opposites.Test –Viva and Written. **(15hrs)**

JAPANEASE:

Course Objectives:

1. Written communication: student can create basic-level German written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.

2. Oral communication: student can create basic-level German oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.

Course Outcomes:
1. Exchange basic greetings in the socialcontext.
2. Respond to classroom directions and basiccommands.
3. Express basic needs in day-to-daylife.
4. Provide and acquire basic personal and socialinformation.
5. Read and write all 71 phonetic Hiragana characters and compoundcharacters.
6. Write and understand basic vocabulary written inHiragana.
7. Form and understand sentences consisting of basic grammar patterns andparticles.
8. Count and understand basicnumbers.
9. Ask and understand the prices of commodities in stores, as well as purchasethem.
10. Ask about the locations and understand the simple directions given to reachthere.
11. Talk about oneself, one's family and friends, likes and dislikes, surrounding objects etc.; using limited vocabulary of nouns, adjectives, verbs, countersetc.
12. Become familiar with Japanese customs, greetings, etiquettesandmanners.
13. Obtain information about Japanese life style, cultural events, food, products, geographical locations, and other socio-culturalphenomena.
14. Develop background for advanced Japanese languagestudies.

Contents:
Introduction of Japanese Language
- Origin, history, development, modern contemporary Japaneselanguage
- Linguistic place of language: language family, area, native speakers,dialects
- Role of language in modern Japanesesociety
- Aspects of Japaneselanguage: written, spoken, communicative Introduction of Japan ascountry
- General class discussion about Japan and its cultural aspects. E.g. Japanese Language, Society, History, Geography, Dressing, Food, Economy, Government and Politics, Technological innovations, Scientific advances, Fine arts, Religion and beliefs, War and peace, Education, Family relations, Work culture and daily life, Travel and tourism, Mass media, Law and order, Literature, Performing arts, Drama, Popular music, Movies and entertainment, Games andSports,
- Environment and Nature and others.
- Introduction of Japanese Language

- Written structure: Scripts- Hiragana, Katakana,Kanji
- Spoken structure: Valid sound patterns, Consonants andvowels
- Introducing oneself inJapanese
- (Hello, How do you do,Iam_____, Nice to meet youetc.)
- Hiragana Script
- Characters (10) from Aa to Ko: Stroke order writing, practice withflashcards
- General words based on completed hiragana characters(10)
- Hiragana Script
- Characters (15) from Ga to Zo: Stroke order writing, practice withflashcards
- General words based on completed hiragana characters(10)
- Hiragana Script
- Characters (15) from Ta to No: Stroke order writing, practice withflashcards
- General words based on completed hiragana characters (15) Introduction of Basic greetings1
- (Good Morning, Good Day, Good Evening, Thank you, Good Byeetc.)
- Hiragana Script
- Characters (15) from Ha to Po: Stroke order writing, practice withflashcards
- General words based on completed hiragana characters(15)
- Hiragana Script
- Characters (16) from Ma to N: Stroke order writing, practice withflashcards
- General words based on completed hiragana characters (20) Counting inJapanese
- Basic numbers (1 to 10), 2, 3 and 4 digit numbers. Reading and Writing fromdigits to Japanese and viceversa.
- Hiragana Script
- Rules for sound prolongation and its expression usinghiragana.
- Prolongation using 'u' and B. Prolongation usingvowels.
- General words based on hiragana prolonged characters (10) Grammar
- Basic sentence pattern 'A wa B desu', 'A wa B desuka'.
- Introduction of particles 'wa'and 'ka', copula 'desu/dewaarimasen'.
- Hiragana Script
- Rules for writing compound characters and its expression usinghiragana.
  o Small characters 'Ya', 'Yu', 'Yo' and B. Small character'Tsu'

- General words based on hiragana compound characters **(15)**
- Grammar **(15hrs)**

SPANISH:

Course Objectives:
1. Written communication: student can create basic-level Spanish written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.
2. Oral communication: student can create basic-level Spanish oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.

Course Outcomes:
After the successful completion of this course, the student should be able to:
1. Exchange basic greetings in the social context.
2. Respond to classroom directions and basic commands.
3. Express basic needs in day-to-day life.
4. Provide and acquire basic personal and social information.
5. Read and write all characters and compound characters.
6. Form and understand sentences consisting of basic grammar patterns and particles.
7. Count and understand basic numbers.
8. Ask and understand the prices of commodities in stores, as well as purchase them.

Contents:

Weeks 1-3:   Capítulo 1:
Elvocabulario: Saludos y despedidas
En la clase La gramática: el alfabeto, los números 0-199, los días, los meses, lasestaciones, el verboser, Los pronombrespersonales, los sustantivos, los artículos, los adjetivos

Weeks 4-6:   Capítulo 2:
Elvocabulario: Las descripciones y lasacionalidades, ¿Quéhaces? ¿Quétegustahacer? La gramática: la hora, preguntassí/no, la negación, laspalabrasinterrogativas, el verbotener, Los verbosregulares en el presente -ar, -er, -ir

Weeks 7-9:   Capítulo 3:
Elvocabulario: Las materiasacadémicas y la vidastudiantil Los edificios de la Universidad La gramática: los números 199-3.000.000, los adjetivosposesivos, los verbosir, hacer, y estar, Las expresiones con el verbotener, el uso de los verbosser/estar

Weeks 10-12:Capítulo 4:
Elvocabulario: Miembros de la familia El ocio La gramática: los verbos "boot," los verbosponer, salir, y traer, los verbos saber/conocer, Los complement sdirectos y suspronombres, la "a" personal, Los adjetivos y los pronombres demostrativos

Weeks 13-15:Capítulo 5:
Elvocabulario:Las actividadesdiarias Losquehaceres domésticos Lagramática: los verbosreflexivos, el superlativo, el presenteprogresivo, Las comparaciones de igualdad y de desigualdad(15hrs)

Environmental Science

Course objectives:
1. Students will develop a sense of community responsibility by becoming aware of scientific issues in the larger social context.
2. recognize the interconnectedness of multiple factors in environmental challenges

Course Outcomes:
1. Apply the knowledge of environmental pollution & importance of current environmental issues
2. Able to understand environment quality standards
3. Able to utilize natural resources properly

Contents:
UNIT I - Environmental Pollution & Current Environmental Issues of Importance
Air Pollution, Water pollution, Climate Change and Global warming: Effects, Acid Rain, Ozone Layer depletion, Photochemical Smog, Waste water treatment. **(4hrs)**
UNIT II- Environment Quality Standards
Ambient air quality standards, Water quality parameters; Turbidity, pH, Suspended solids, hardness, residual chlorine, sulfates, phosphates, iron and manganese, DO, BOD, COD. **(4hrs)**
UNIT III - Natural Resources
Water Resources, Mineral Resources, Soil, Energy - Different types of energy, Conventional and Non-Conventional sources - Hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Geothermal energy and Bio-gas. **(4hrs)**

Books:
1. Environmental Chemistry by B.K. Sharma & H. Kaur, Goel Publishing House.
2. Environmental Chemistry by A. K De, New Age International Publishers.

Reference Books
1. Instrumental method of Analysis by B.K. Sharma, Goel Publishing House.
2. A Test Book of Environmental Chemistry & Pollution Control by S. S. Dara, S. Chand and Co.
3. Environmental Chemistry by Samir K. Banerjee, Prentice Hall of India Pvt. Ltd. New Delhi.

TERM - II
Integral& Multiple Calculus
Course Objectives:
1. To introduce the concepts of Integral calculus in the field of Engineering.

2. To develop skills in student to apply the concepts of multiple integral in various engineering problems

Course Outcomes:
1. Trace various curve and use integral to solve engineering problem.
2. Use special integral in solving engineering problems.
3. To solve various applications of engineering problems using multiple integral.

Content:
Integral Calculus: Review of Curve tracing , Gamma function, Beta function, Relation between beta and gamma function, applications to area, length, volume and surface area, Differentiation under integral sign. **(12hrs)**

Multiple Integral-I: Double integral, Change of variables, Change order of integration, Triple integral. **(6hrs)**

Multiple Integral-II (Applications): Applications of multiple integral such as area, mass, volume, centre of gravity ,moment of inertia Questions related to multiple integral in GATE. **(12hrs)**

Books:
1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2013, Tenth Ed.
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2013, Forty Third ed.
3. Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K, Narosa Publishers, Alpha Science International, Ltd, 2007, Third Ed.
4. Advanced Mathematics for Engineers and Scientists, Spiegel, M. R, McGraw-Hill, 2010, Second Ed.

Ordinary & Partial Differential Equations

Course Objectives:
1. To develop skills in student to solve problems of Ordinary Differential Equations and its applications in field of engineering.
2. To introduce the concepts of Partial Differential Equations and its applications in the field of Engineering.

Course Outcomes:
1. Solve first order, first degree & higher order differential equations
2. Form and solve the differential equations in engineering.
3. Understand and solve Partial differential equations in engineering problems

Content:
First order first degree differential equations: Linear, Reducible to linear and exact differential equations. **(3hrs)**
Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Legendre homogeneous differential equations. **(4hrs)**

Simultaneous differential equations, Special types of differential equations, Applications of differential equations to engineering systems. **(4hrs)**
Introduction to Partial Differential equations, Partial differential equation of first order and its types, applications to real life problems. **(4hrs)**

Books:
1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2013, Tenth Ed.
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2013, Forty Third ed.
3. Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K, Narosa Publishers, Alpha Science International, Ltd, 2007, Third Ed.
4. Advanced Mathematics for Engineers and Scientists, Spiegel, M. R, McGraw-Hill, 2010, Second Ed.

Bio Systems In Engineering

Course Objectives:
This course introduces general biological concepts
1. It helps students to understand importance of biological concepts in engineering fields.
2. To understand application of engineering concepts in medical instrumentation.

Course Outcomes:
1. Understand the use of basic biology in engineering
2. Understand & Apply the concepts of engineering for design of biomedical instrumentation
3. Understand application of engineering in bio sensors & robotic prosthesis
4. Understanding telemedicine & wireless telemetry in medical

Content:
Human Physiology & Anatomy: Introduction to Human Physiology, the Nervous System, Cardiovascular System **(5hrs)**
Biomedical Instrumentation: Bio-imaging techniques, ECG, Computer aided ECG, X-Ray, Portable MRI, CT Scan,Portable scanners, Blood pressure measurement instrument, spirometry, advanced medical instruments. **(7hrs)**
Bio sensors & Robotic prosthesis: Introduction & types of biosensors, its applications, prosthesis, application in healthcare services, robotic surgery. **(8hrs)**
Telemedicine & Wireless Medical Telemetry: Introduction, Benefits & Drawback, History, Types& Categories: Store & Forward, Remote Monitoring, Real- Time Interactive, Future of Telemedicine Wireless medical telemetric devices. **(5hrs)**
Case Studies: Role of Engineers in various disciplines of medical science:
Civil- Biomechanics
Mechanics- Biomaterial & 3D Bio printing
ETC. ETRX & EE- Sensors & transducers
IT & CSE- Neurotranslator& prosthesis **(5hrs)**

Books:
1. Biomedical Instrumentation, Dr. M. ArumugamAnuradha, 2002 Second

IOT Practical
Course objectives:
1. To understand key technologies in Internet of Things.
2. Analyze, design or develop parts of an Internet of Things solution
3. Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes:
1. Identify and adopt knowledge of the terminology, requirements and constraints for IoT development.
2. Demonstrate IoT system for smaller applications.

Content:
1. Introduction to Internet of things
2. Hands on Raspberry Pi and programming.
3. Controlling different displays like LED, Seven Segment, LCD etc, using IoT
4. Data acquisitions, monitoring and and cloud services.

Books:
1. IoT: Building Arduino-Based Projects, Peter Waher, PradeekaSeneviratne, Brian Russell, Drew Van Duren, Packt Publishing Ltd., 2016
2. Internet of Things with the ArduinoYún, Marco Schwartz, Packt Publishing Ltd., 2014
3. Building Arduino Projects for the Internet of Things, AdeelJaved, Apress, 2016
4. the Internet of Things, Donald Norris, McGraw-Hill Education, 2015

Applied Physics
Course Objectives:
1. Demonstration of the fundamentals of Quantum Mechanics and its related applications.
2. Introduction to the working and applications of fundamental lasers.
3. Familiarization and demonstration of the concepts of interference and polarization and it's application
4. Explanation of theconcepts of semiconductor physics and working of various diodes.

Course Outcomes:
1. Apply the knowledge of Quantum Mechanics to solve related problems and it's applications.
2. Explain the fundamentals of laser & identify it's applications.
3. Describe the phenomenon of interference & polarization to solve concerned problems & applications.
4. Demonstrate the knowledge of semiconductor to use related devices and it's applications.

Content:
Unit I: Quantum Mechanics: Compton Effect & its applications, Heisenberg's Uncertainty principle & its applications, Schrödinger's wave equation and its application viz. Eigen values and Eigen functions of "particle in a box", quantum constriction, quantum computing. **(10hrs)**

Unit II: Optics : Interference and Polarization and its applications viz. Antireflection coatings, filters, Polaroid's, LASER and its applications viz. Holograms, printers. **(10hrs)**

Unit III: Semiconductors: Basics of semiconductor physics, Hall Effect, types, devices viz. pn junction diode & its applications. **(8hrs)**

Books:
1. Physics for Engineering, Dr. B P Butey, Oxford University Press, 2017, First Ed
2. Fundamentals of Physics, David Halliday and Robert Resnik, New Age, 1994, Fourth Ed
3. Nanotechnology, Dr. Sulbha K Kulkarni, Capital Publishing Co, 2011, Second Ed

Introduction To Digital System Design
Course Objectives:
1. To familiarize with various Digital IC
2. To understand basic fundamentals of Digital circuits.
3. To prepare for various engineering applications.

Course Outcomes:
1. Solve the problems on Number system codes and their conversions.
2. Identify Digital IC and implement in the circuits.
3. Create, design and simulate canonical logic forms
4. Demonstrate the application of combinational and sequential logic circuits.

Content:
Unit I: Number Systems & Boolean Algebra
Decimal, binary, octal, hexadecimal number system and conversion, binary weighted & non-weighted codes & code conversion, signed numbers, 1s and 2s complement codes, Binary arithmetic, Binary logic functions , Boolean laws, truth tables, associative and distributive properties, De-Morgan's theorems, realization of switching functions using logic gates. **(10hrs)**

Unit II: Combinational Logic:
Switching equations(Mathematical operations), canonical logic forms, sum of product & product of sums, Karnaugh maps, two, three and four variable Karnaugh maps, simplification of expressions, mixed logic combinational circuits, multiple output functions, QuineMcluskey Methods for 5 variables.
Introduction to combinational circuits, code conversions, decoder, encoder, priority encoder, multiplexers & De-multiplexer, binary adder, substractor, BCD adder, carry lookahead adder, Binary comparator, Arithmetic Logic Units **(10hrs)**

Unit III: Sequential Logic & Circuits:
Latch, flip-flops, clocked and edge triggered flip-flops, timing specifications, asynchronous and synchronous counters, counter design, Registers, types of registers. Analysis of simple synchronous sequential circuits, Introduction to Mealy and Moore Circuits. **(10hrs)**

Books:
1. Digital Electronics, R P Jain, McGraw Hill, 2017, Second Edition
2. Digital Logic and Computer Design, Morris Mano, PHI, 2017 review, Second Edition
3. Digital Electronic Principles, Malvino, PHI, 2011-13, Seventh Edition

Embedded Programming

Course Objectives:
1. To give the awareness of major embedded devices.
2. To give the knowledge about interfacing devices.

Course Outcomes:
1. Recognize and analyze given embedded system design and its performance.
2. Demonstrate application based competencies in Embedded Programming.

Content:
1. Introduction to Embedded system and programming.
2. Hands on Arduino board and its IDE.
3. Interfacing LEDs, switches, seven segment display, LCD, LDR, and Potentiometer.
4. Applications usingTemperature, IR, Buzzer, finger print sensor.

Books:
1. Designing Embedded Systems with Arduino: A Fundamental Technology for Makers, Tianhong Pan(Author), YiZhu(Author), Springer, 2017, First
2. Getting Started With Arduino 3rd Edition, Massimo Banzi, Michael Shiloh, Maker Media, 2014, Third
3. Arduino-Based Embedded Systems: Interfacing, Simulation, and LabVIEW GUI, Rajesh Singh, Anita Gehlot, Bhupendra Singh, SushabhanChoudhury, CRC Press, 2017, First
4. (Make) Lego and Arduino Projects, John Baichtal, Matthew Beckler and Adam Wolf, Maker Media, 2012, First
5. Arduino projects for Engineer, NeeraprajRai, BPB publication, First Edition, 2016.

Digital Fabrication

Course Objectives:
1. To familiarize with basic CAD modeling and digital manufacturing methods.
2. To equip with various techniques to create prototype & product design and developments.
3. To train in 3 D part modeling and additive manufacturing appropriately
4. To understand the concept of rapid tooling and its requirement

Course Outcomes:
1. Understand and use techniques for processing of CAD models for rapid prototyping
2. Understand and apply fundamentals of rapid prototyping techniques.
3. Use appropriate tooling for rapid prototyping process.
4. Select the processing parameters best suited to the production of prototype
5. Incorporate and select right approaches and considerations for successfully developing new product designs.

Content:
Introduction to Additive Manufacturing - 3 D Printing and Computer aided design Software's – CATIA v52 D Sketching on CATIA v5 - To prepare 2D geometrical model by using sketcher toolbar, entities and Views
2 D Sketching on CATIA v5 - To prepare 2D geometrical model using drawing constraint and modifying toolbars.
3D Modelling on CATIA v5– To prepare part model using 2 D drawing and with basic extrusion tools.
- Conversion of part file to .stl format
- 3D Modelling on CATIA v5 - To prepare part model using Revolve command
- Conversion of part file to .stl format
- 3 D Printing Slicing / Pre-processing
- To pre-processed model for 3 D Printing using of Kissslicer/Cura 4.0 Software's
- 3 D Printing Slicing - Development of g.code by using Kissslicer/Cura 4.0 Softwares for 3 D Printing
- 3 D Printing – Introduction to Fused deposition modelling technique
- Introduction to FDM Machine and operating controls.
- 3 D Printing – Development of prototype using additive manufacturing – 3 D Printing
- Case- Studies   **(30hrs)**

Books:
1. Gibson, I, Rosen, D W., and Stucker, B.,Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
5. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer
6. Bartolo, P J (editor), Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, Taylor and Francis, 2007.
7. Hopkinson, N, Haque, R., and Dickens, P., Rapid Manufacturing: An Industrial Revolution for a

Digital Age: An Industrial Revolution for the Digital Age, Wiley, 2005.
8. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
9. Rapid Prototyping by M. Adithan, Atlantic Publication.

Mini-Model Through Innovation And Creativity

Course Objective:
1. To enhance the skill of planning ad designing.
2. To implement basic concepts.
3. To develop innovative and creative learning.

Course Outcomes:
1. Demonstrate the skills of planning and designing for developing a working mini model.
2. Implement knowledge of concepts learnt and workshop practices to prepare a model.
3. Use innovative ideas and convert these into physical models.

Communication Skills

Course Objectives:
1. To develop an understanding in the students regarding communication skills
2. To develop the four essential communication skills in students i.e. – reading, writing, listening and speaking
3. To develop the vocabulary and English proficiency of the students

Course Outcomes:
1. To demonstrate oral communication in a formal manner
2. To apply vocabulary for demonstrating English proficiency.
3. Development of Reading Skills.
4. Development of Writing Skills.
5. Development of Listening Skills.
6. To use grammar for appropriate communication.

Content:
Basics of Grammar(Noun, Pronoun, adjective, verbs, tenses, punctuation), 7 Cs of Communications, Communication Process, Presentation Skills and Mock Presentation, Essay and Creative writing, Effective Writing, Skills: Elements of Effective Writing Email Etiquettes, Listening (Voice Versant), Ad making, Story Telling, IETLS training, BEC Training, Group Discussion and mock Gds, Self-Introduction, Book Review and Elocution. **(45hrs)**

Books:
1. Effective Technical Communication, M. Ashraf Rizvi, Tata McGraw Hill, 2012, First
2. Communication Skills, Sanjay Kumar and Pushpata, Oxford University Press, 2015, Second

3. High School English Grammar and Composition, P C Wren and H Martin, S Chand, 2005, Revised First

Entrepreneurship

Course Objectives:
1. To make students aware of the need self-earning system.
2. To develop interest in creative business ideas.
3. To make them capable of becoming entrepreneurs.

Course Outcomes:
1. Develop self-confidence to become an entrepreneur.
2. Develop a creative thinking for growth of self and society.

Content:
Lesson 1: Let's Get Started
- Form teams that students will work with for the entire duration of the course.
- Learn how entrepreneurship has changed the world.
- Learn what entrepreneurship is.
- Identify six entrepreneurial myths and uncover the true facts.

Learn how entrepreneurship has changed your country through a class discussion. **(2hrs)**

Lesson 2: Explore E-cells on Campus
- Appreciate the fact that E-cells help shape career dreams and develop skills required to build a successful career.
- Understand how E-cells can transform individuals into successful leaders and entrepreneurs.
- Get inspired by the success story of Local Entrepreneurs.
- Express your dreams. **(2hrs)**
- **Lesson 3:Listen to Some Success Stories**
- Understand how ordinary people become successful global entrepreneurs, their journeys, their challenges, and their successes.
- Understand how ordinary people from their own countries have become successful entrepreneurs. **(2hrs)**

Lesson 4: Characteristics of a Successful Entrepreneur
1. Understand the entrepreneurial journey and the concept of different entrepreneurial styles.
2. Understand each of the five entrepreneurial styles in the model and how they differ from each other.
3. Identify your potential entrepreneurship style based on personality traits, strengths, and weaknesses.
4. Understand how different entrepreneurship styles work, and how people with different styles work together. **(2hrs)**

Lesson 5:Design Thinking

1. Understand Design Thinking as a problem-solving process.
2. Describe the principles of Design Thinking.
3. Describe the Design Thinking process. **(2hrs)**

Lesson 6: Sales Skills to Become an Effective Entrepreneur

1. Understand what customer focus is and how all selling effort should be kept customer-centric.
2. Use the skills/techniques of personal selling, Show and Tell, and Elevator Pitch to sell effectively. **(4hrs)**

Lesson 7: Managing Risks and Learning from Failures

1. Understand that risk-taking is a positive trait
2. Identify risk-taking traits and resilience traits
3. Appreciate the role of failure on the road to success and understand when to give up**(2hrs)**

Lesson 8: Orientation Program in Entrepreneurship

Identify the reasons why people want to become entrepreneurs.

1. Help participants identify why they would want to become entrepreneurs.
2. Give participants the real picture of the benefits and challenges of being an entrepreneur. **(2hrs)**

Books:

1. Stay Hungry Stay Foolish,RashmiBansal, Westland, 2008

Waste Management

Course objectives

1. To study industrial waste generation patterns, as well as management and disposal techniques
2. To categorize different types of waste

Course Outcomes

1. To apply creative & innovative practices for waste management.
2. To identify hazardous and non-hazardous waste
3. To describe the major categories of waste, disposal techniques and technologies.

Contents

1. Case study of Physiochemical analysis of water from different sources (River/lake/well/bore well)
2. Case study of physiochemical analysis of solid waste (industrial / municipal)
3. Case studies on best practices of solid waste management
4. Visit to a solid waste processing unit
5. Case studies on e-waste
6. Case studies on biomedical waste
7. Case studies biomass generation from organic waste
8. Waste water source of pollution and treatment techniques from Nagpur water resources.

Books:

1. Environmental Chemistry,B.K. Sharma & H. Kaur, Goel Publishing House, 2014, fourth ed.
2. Environmental Studies, R. Rajgopalan, Oxford Publication, 2016, hird ed.
3. A Test Book of Environmental Chemistry & Pollution Control, S. S. Dara, S. Chand and Co., 2007, seventh ed.

Introduction To Biochemistry
(OPEN ELECTIVE)

Course Objectives

1. Deals with the study of structural and functional aspects of biomolecules.

Course Outcomes

1. Able to understand basics of biochemistry
2. Apply the knowledge of metabolism of carbohydrates.
3. Discuss the structure, properties and reactions of proteins and amino acids
4. Discuss the structure, properties of fats
5. Demonstrate the knowledge of advanced trends in biochemistry

Contents:

Unit I - Carbohydrates, Lipids And Proteins

Monosaccharide's, complex carbohydrates, glycoprotein's, Lipids and cell membranes – types of membrane lipids, phospholipids and glycolipids from bimolecular sheets, Protein structure and function – Primary, Secondary, Tertiary, Quaternary Structures. **(8hrs)**

Unit II- Metabolism Of Carbohydrates
Glycolysis, Glucogenesis, Citric acid cycle and Glycogen metabolism **(5hrs)**

Unit III- Protein Metabolism
Protein turnover and Amino acid catabolism, Biosynthesis of amino acids **(5hrs)**

Unit IV- Fatty Acid Metabolism And Nucleic Acid Metabolism

Overview of Fatty Acid Metabolism, synthesis and degradation of fatty acids, De novo synthesis of Nucleotides. **(6hrs)**

Unit V- Advanced Trends In Biochemistry (6hrs)

Books:

1. Biochemistry, Jeremy M.Berg, W.H. Freeman and Company, 2014, 5th ed
2. Biochemistry, Rastogi, Tata Mc Graw Hill, 2014, 4th Ed.
3. Biochemistry, Stryer L W.H. Freeman and Company, 2007, 7th Ed.

Smart Materials (OPEN ELECTIVE)

Course Objectives

1. Introduction of the Smart Materials and its classification on the basis of structure.
2. Introduction to the concept of various smart materials like metallic glass, shape memory alloys, piezoelectric, magnetostrictive, and photonic materials

3. Introduction to the applications of smart materials in various engineering fields.

Course Outcomes: Student shall be able to

CO1: understand the concepts of Smart materials and its classification.

CO2: Apply the knowledge of metallic glasses to understand working of devices based on it.

CO3: Apply the knowledge of piezoelectric materials to understand related applications.

CO4: Apply the knowledge of photonic materials to understand its applications.

CO5: Apply the knowledge of superconductors to understand its applications.

CO6: Demonstrate the knowledge of advanced topics related to Metallic Glasses, SMA, piezoelectric, photonic and superconductors

Content:

Introduction to Smart Materials:
Introduction to crystal structures, Introduction to the concept of Smart Materials & composites. **(3hrs)**

Metallic glasses and Shape Memory Alloys:
Metallic glasses and bulk metallic glasses, shape memory alloys: types and applications in engineering fields. **(5hrs)**

Piezoelectric Materials & Composites:
PVD & its applications. **(5hrs)**

Photonic Materials:
Solar cells, smart coatings and photo biology. **(4hrs)**

Super Conductors:
Types I and type II Super Conductors ,Meissner effect, critical current, Josephson effect, High temperature superconductors, and their engineering applications, quantum super conductor. **(5hrs)**

Advanced trends in smart materials:
Introduction to thin film and devices. **(3hrs)**

Books:
1. Elementary solid state Physics, M. Ali Omar, Pearson Education Inc., 2009, Sixth Ed
2. Engineering Physics, B.K.Pande and S.C.Chaturvedi, Cengage Learning Pvt Ltd, 2012, First Ed

Smart Structure and Materials, Brian Culshaw, Artech House – Boston. London, 1996, Second Ed

Nanomaterials and Sensors (Open Elective)

Course Objectives:
1 Demonstration of the structures and classification of nano-materials.
2 Introduction to the properties of nano-materials.
3 Demonstration of various Synthesis and fabrication techniques of nano-materials.
4 Explanation of various Characterization techniques of nano-materials.
5 Introduction to various types of nano-sensors.
6 Explanation of design and application of various nano sensors used in 1U/3U satellites.

Course Outcomes: Student shall be able to
1 Identify various structures and classification of nano-materials.
2 Describe properties of nano-materials.

3 Illustrate various Synthesis and fabrication techniques of nano-materials..
4 Recognize various Characterization techniques of nano-materials.
5 Demonstrate knowledge of various types of nano-sensors.
6 Select and demonstrate design and type of nano-sensors used for various applications in 1U/3U satellites.

Contents

Introduction: Definition of nano materials. Classification of nanostructured materials.

Properties of Materials: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties

Synthesis Techniques: **Bottom up approaches:** Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography

Characterization Techniques: X-Ray diffraction and Scherrer method (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), scanning probe microscopy, atomic force microscopy (AFM), photoluminescence spectra, Raman spectroscopy

Nano Sensors: What are Sensors and actuators, Nano-Sensors and Nano actuators, Types of Sensors, Physical, Chemical, Bio-Sensors and Optical Sensors, Attitude Sensors-Infrared Band-Pass Filter; Star Tracker; Sun Sensor; Analog Sun Sensor; IR Earth Sensor and Space Sextant, Attitude Actuators-Reaction Wheel; Compact Magnetorquer; Magnetorquer Rod, Infrared Spectrometer, Imager

Design, Applications & Future Challenges: Design aspects of compact Nano-Sensor arrays for various applications in 1U/3U satellite, Sensitivity of Sensor, Nanowires, Carbon Nanotubes and its application in space technology.

List of Books
1. Nano science and nanotechnology, M.S Ramachandra Rao, Shubra Singh, Wiley publishers.
2. Applications of Nano-materials in Sensors and Diagnostics, Editors: Tuantranont, Adisorn (Ed.) Springer Series on Chemical Sensors and Biosensors
3. Introduction to Nano Technology, Charles P. Poole, Jr., Frank J Owens, Wiley India
4. Nanotechnology, Jermy J Ramsden, Elsevier publishers
5. Nano Materials, A K Bandyopadhyay, New Age Introduction
6. Nano Essentials, T Pradeep, TMH
7. Nanotechnology the Science of Small, M.A Shah, K.A Shah, Wiley Publishers
8. Principles of Nanotechnology, Phani Kumar, Scitech.

Introduction To Biochemistry
Liberal & Creative Arts

Course Objective
1. To enable the student to have good health
2. To practice mental hygiene.
3. To possess emotional stability.
4. To integrate moral values.

Course Outcomes: Student shall be able to
1. Demonstrate basic skills associated with yoga
2. Demonstrate basic skills associated with yoga activities including strength
3. and flexibility, balance and coordination.
4. Demonstrate an understanding of health-related fitness component

Contents:
Anatomy and Physiology of Yogic Practices

- Introduction to Human Body and systems in brief with special reference to Respiratory, Digestive, Muscular and Nervous systems.
- Postural Physiology with reference to Asana.
- Asana - Definition and Classification, Similarities and dissimilarities between Asana and Exercise.
- Pranayama - Definition and Classification. Difference between pranayama and deep breathing. Importance of Rechaka, Kumbhaka, Puraka.
- Introduction to Kriyas, Mudras and Bandhas in brief.

Yogasana
- Sandhi Snchalan
- Suryanamaskar
- Tadasan
- Vrukshasan
- Vajrasana and its types
- Pavan Muktasana
- Urshtasana
- Om Uchharan

TREM –III

BFYL 108 (Mathematics-V) (Fourier series and Partial Differential Equations)

Teaching Scheme				Credits						ESE Duration Hours
					Theory			Practical	Total	
Th	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
1 H	1 H	-	2 H	2	10	15	25	-	-	50	2

COURSE OBJECTIVES
Students undergoing this course are expected to:
1. To introduce Fourier series and its applications in the field of Civil Engineering.
2. To develop skills to use Partial differential equations and its applications in the field of Civil Engineering.

Course Outcomes
1. To Understand and use Fourier series expansion of periodic functions in the field of Civil Engineering.
2. To apply the concept of partial differential equations and its solutions by a method.
3. Solve problems in Civil Engineering by using Partial differential equations.

Course Contents
UNIT I - Fourier series: Concepts of periodic functions and its Fourier series expansion, Fourier series of even & odd functions, Half range sine & cosine series, Parseval's identity **08**
UNIT II - Partial differential: Review of Partial differential equation of 1st order & 1stdegree, Higher order partial differential equations and method of separation of variables. **08**
UNIT III- Applications: Applications of PDE in Civil engineering. **08**

Text Books
1. Higher Engineering Mathematics, Grewal B.S.: Khanna Publishers; 2013 Forty Third

Reference Books
1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2013, Tenth
2. Advanced Engineering Mathematics Jain, R.K. and Iyengar, S.R.K Narosa Publishers; Alpha Science International, Ltd., 2007, Third
3. Advanced Mathematics for Engineers and Scientists, Spiegel, M. R McGraw-Hill 2010, Second

BCEL224:Fluid Mechanics (Theory)
(Lectures–Tutorial–Practical-Credit) / Week (1-0-2-3)
Total Hrs: 30 Marks-75

Course objective
1. To study the basic behavior of fluids and fluid system and the laws governing this behavior
2. To understand and apply the basic concepts of Fluid Mechanics to carry out professional engineering activities in the field of fluids.
3. To apply scientific strategies to analyze qualitatively and quantitatively the problems and give solutions.

Course Outcomes: Student shall be able to
CO1. classify the various properties of fluid and its behavior
CO2 Analye hydrostatic forces in submerged bodies
CO3 Identify type of flow for compressible and in compressible fluid
CO4 Explain the concepts of dynamics of fluid flows and the governing non-dimensional parameters

Unit-I Kinematics of Fluid flow: Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrigational flows, compressible and incompressible flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body. **Hrs-04**
Unit-II Fluid Statics Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, **Hrs-04**

Unit-III Dynamics of Fluid Flow : Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends .**Hrs-04**

Unit-IV Laminar and Turbulent Flow:
Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, **Hrs-04**

Text Books:
1. Modi, P.N., and Seth, S.H., Hydraulics and Fluid Machines 19th Edition, Standard, Book House, 2011
2. F M White, Fluid Mechanics, Tata McGraw Hill Publication 2011. .

Reference Books: (At Least 04 to 05)
1. Som S.K. & Biswas G, Introduction of fluid mechanics & Fluid Machines, 2ndEdition, TMH, 2000
2. Garde, R.J, Fluid Mechanics through Problems, 2ndEdition, New Age International, Pvt. Ltd, New Delhi, 2005
3. Robert W. Fox, Philip J. Pritchard, Alan T. McDonald, Introduction to Fluid Mechanics,Student Edition Seventh, Wiley India Edition, 2011.
4. Shames, Mechanics of Fluids, McGraw Hill Book Co., New Delhi, 1988.
5. Streeter V.L., Benjamin Wylie, FluidMechanics, McGraw Hill Book Co., New Delhi, 1999.

e- Learning Resources:
   www.nptel.iitm.ac.in/iitkanpur. & www.nptel.iitm.ac.in/iitDelhi.

BCEL224Fluid Mechanics (Practical)
List of Practical's
Total Hrs: 02/Week Marks-25

Course Outcome: Student shall be able to
C01 Understand the various properties of fluid and its behavior
C02 Identify type of flow for compressible and in compressible fluid
C03 Compute hydrostatic forces in submerged bodies
C04 understand the concepts of dynamics of fluid flows and the governing non-dimensional parameters,
C05 Apply concepts of mass, momentum and energy conservation to flows
C06 Understand the basic ideas of turbulence.
PR-1 To verify Bernoulli's theorem **C01**
PR-2 To determine co-efficient of discharge of Venturimeter. **C02**
PR-3 To determine co-efficient of discharge of Orifice Plate. **C03**
PR-4 To determine co-efficient of discharge of Rectangular Notch. **C02**

PR-5 To determine co-efficient of discharge of Triangular Notch. **C04**
PR-6 To determine co-efficient of discharge, contraction & velocity of an orifice. **C06**
PR-7 To verify momentum equation using the experimental set-up on diffusion of submerged air jet **C05**
PR-8 To determine co-efficient of discharge of Orificemeter. **C06**
PR-9 To find a critical Reynold's number for a pipe flow **C04**
PR-9 To determine the meta centric height of a floating body **C03**
PR-10 To determine head loss in pipe (Expansion, Contraction and Bend) **C02**

BCEL225:Hydrology & Water Resource Engineering (Theory)
(Lectures–Tutorial–Practical-Credit) /
Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To understand the hydrological cycle and its process.
2. To understand the infiltration characteristics of runoff
3. To characterize developing hydrograph.

Course Outcome: Student shall be able to
C01 Classify hydro-meteorological parameters & estimate abstractions from precipitation
C02 Apply the mechanism of Evaporation, Transpiration and Evapotranspiration in real life situation
C03 Analyze rainfall-runoff models and analysis of hydrographs
C04 Interpret hydrologic flood routing models for recharging through rain water harvesting.

Unit-I Introduction.
Hydrological Equations and brief description of its components. Importance of temperature, wind and humidity in hydrology. Earth and its atmosphere and importance. Definition and classifications. Selection of site, density and adequacy of rain-gauge station. **Hrs-04**

Unit-II Infiltration: Definition, mechanism, factors affecting, numerical.
Evaporation: Definition, mechanism, factors affecting, numerical.
Transpiration: Definition, mechanism, factors affecting. Numerical. **Hrs-06**

Unit-III Run off : Source components of runoff, classification of streams, factors affecting. Estimation of discharge and Measurement methods, numerical.
Hydro graphs:
Unit hydrographs. Base flow and base flow separation, S-Curve theories Numerical. **Hrs-10**

Unit-IV Floods
Causes and effects, factors affecting Flood routing and flood forecasting, numerical.
Ground water recharge
Recharging methods, spreading methods. Recharge through rain water harvesting. **Hrs-10**

Text Books:
1. Dr. P. Jaya and Rami Reddy, Text book of hydrology, 3rd Edition, Laxmi Publication, 2007
2. R. K. Sharma and T. K. Sharma, Text book of hydrology and water resource engineering, 5th Edition, Dhanpat Rai Publications, 2007

Reference Books: (At Least 04 to 05)
1. Subrahmanya, K., 2008, Engineering Hydrology, Tata McGraw Hill Pub. Co., New Delhi.
2. Viesmann W and Lewis G Lt (2008) "Introduction to Hydrology". Prentice Hall of India.
3. Chow, V. T., Maidment and Mays, L. A., 2010, Applied Hydrology, Tata McGraw Hill Pub. Co., New York.

e- Learning Resources:
www.nptel.iitm.ac.in/iitkanpur.
www.nptel.iitm.ac.in/iitDelhi.

BCEL 221:Materials, Testing & Evaluation (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-2-4)
Total Hrs: 16 Marks-50
Course Objectives:
1. Make measurements of behavior of various materials used in Civil Engineering
2. Introduce experimental procedures and common measurement instruments, equipment, devices
3. Exposure to a variety of established material testing procedures and techniques

Course Outcome: Student shall be able to
C01 Observe various modes of failure in compression, tension, and shear
C02 Document the experimental program including the test procedures, collected data, method of interpretation and final results
C03 Measure physical properties of common structural and geotechnical construction materials
C04 Interpret the laboratory data including conversion of the measurements into engineering values and derivation of material properties (strength and stiffness) from the engineering values

Syllabus
Unit-I   Introduction to Engineering Materials
Cements, M-Sand, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these
Hrs-05
Unit-II Mechanical behavior and mechanical characteristics
Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundamels and characteristics; Brittle fracture of steel – temperature

transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics **Hrs-05**

Unit-III Standard Testing & Evaluation Procedures covering
Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep
Hrs-06

Text Books:
1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Materials and PavementTesting', Nem Chand& Bros, Fifth Edition

Reference Books:
1. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
2. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
3. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards(post 2000)

BCEL 221:Materials, Testing & Evaluation (Practical)
Total Hrs: 02/Week Marks-25
Course Outcome: Student shall be able to
C01 Observe various modes of failure in compression, tension, and shear
C02 Document the experimental program including the test procedures, collected data, method of interpretation and final results
C03 Measure physical properties of common structural and geotechnical construction materials
C04 Interpret the laboratory data including conversion of the measurements into engineering values and derivation of material properties (strength and stiffness) from the engineering values

List of Practical's
PR-1 Gradation of coarse and fine aggregates **CO2**
PR-2 Compressive strength test on aggregates **CO1**
PR-3 Tests on unmodified bitumen and modified binders with polymers **CO3**
PR-4 Bituminous Mix Design and Tests on bituminous mixes - Marshall method **CO3**
PR-5 Different corresponding tests and need/application of these tests in design and quality control **CO3**
PR-6 Tensile Strength of materials & concrete composites **CO1**
PR-7 Tension I - Elastic Behaviour of metals & materials **CO1**
PR-8 Tension II - Failure of Common Materials **CO4**

PR-9	Torsion test	CO1
PR-10	Hardness tests (Brinnel's and Rockwell)	CO1
PR-11	Soil Classification	CO2
PR-12	Consolidation and Strength Tests	CO3

BCEL 222: MECHANICS OF MATERIAL (Theory)
(Lectures–Tutorial–Practical) / Week (1-1-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To study the various mechanical properties of materials.
2. To provide systematic methods for solving engineering problems in solid mechanics.
3. To use the fundamental concepts of stress, strain and elastic behavior of materials.

Course Outcome: Student shall be able to
C01 Understand the linear & lateral stresses in sections
C02 Construct the shear force and bending moment diagrams
C03 Develop the bending stress and shear stress distribution of beam
C04 Design the hollow & solid shafts for torsional stresses
CO5 Evaluate the slope and deflection of beams subjected to loads
CO6 Determine the principal stresses and principal planes

Syllabus
Unit-I Mechanical Properties and Uniaxial Problems: Concept of stress and strain, Stress strain behavior of ductile and brittle material in uniaxial state of stress. Elastic constants, Relation between elastic constants. Uniaxial loading and deformation of simple cases of statically indeterminate problems under axial loading. **Hrs-06**

Unit-II Shear Force & Bending Moment Diagrams: Determination of shear forces and Bending moment at a section, SF and BM diagram in beams, Differential relation between shear force and bending moment, Relation between load and shear force. **Hrs-05**

Unit-III Shear & Bending Stresses in Beam: Bending stresses in simple beam, Assumptions and derivation of simple bending, Homogeneous and composite beams. Shear stresses in simple beams, shear stress distribution, Shear Stress in composite beams.
Torsion of Shafts: Torsion of circular sections, Assumptions and derivation of relations between torsional moment, Shear stresses and angle of twist. Torsional stress in solid and Circular sections **Hrs-09**

Unit-IV Slope & Deflection of determinate beams: Differential equation relating deflection and moment shear and load, Deflection of simple beams by integration. **Hrs-05**

Unit-V State of Stress In Two Dimensions: State of stress in two dimensions, Differential equation of equilibrium, Transformation of stresses , Principal stresses, Maximum shear stresses, Mohr's circle, Combined bending and torsion, Combined effect of Torsion and Shear. **Hrs-05**

Text Books:

1. R. K. Rajput, Strength of material, 4th Edition, S.Chand, 2006
2. Beer and Johnston, "Mechanics of Material", Tata Mc Graw Hill publication

Reference Books:
1. James Gare, Mechanics of Material, 8th Edition, Cengage Learning, 2012
2. B. C. Punmia, Mechanics of Material, 15th Edition, Laxmi Publications, 2005
3. Gere and Timoshenko, "Mechanics of Materials", CBS publishers

Online Certification Courses:
1. Strength of Materials, Prof. Sriman Kumar Bhattacharyya, IIT Kharagpur. (NPTEL Course)

Best faculty members from IIT:
1. Prof. Sriman Kumar Bhattacharyya, IIT Kharagpur
2. Dr. A. D. Ghare, Professor, VNIT, Nagpur
3. Dr. R. S. Jangid, Professor, IIT, Bombay

BCEL 223 Soil Mechanics-I (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-2-4)
Marks-75 Total Hrs: 30

Course Objective :

Course Outcome: Student shall be able to
CO1 Characterize and classify different types of soils
CO2 Identify the methods for determination of soil properties and different types of classification systems
CO 3 Implement the concepts of flow of water through soil
CO 4 Apply the concept of compaction and consolidation on field

Unit-I Introduction & Physical properties of soil:: Introduction to Soil and Soil Mechanics, Civil Engineering problems related to soils, Complexity of soil nature, Soil formation and soil types, Soil- a three-phase system, Solids-water-air relationships, water content, void ratio, porosity, degree of saturation, unit weight, specific gravity, their interrelationships and Laboratory determination **Hrs-07**

Unit-II Index properties of soil & Classification of soils:: Grain size distribution by sieve analysis, Consistency of clays and determination, Atterberg's limits and indexes as per IS code, Necessity of classification, criteria for classification, classification based on grain size and plasticity, Indian standard classification system **Hrs-07**

Unit-III Permeability & Seepage analysis: Darcy's law, methods of determination of coefficient of permeability of soils – constant head and falling head permeability tests, factors affecting permeability, approximate coefficient of permeability of common soils, field permeability tests, Seepage pressure, upward flow, quick condition, two-dimensional Laplace equation, Flow net and its properties Effective Stress Principle **Hrs-07**

Unit-IV Soil compaction: Necessity of compaction in field, Standard Proctor test, Modified Proctor test, compaction curve, OMC and Maximum dry density, Compaction curve for sand, factors affecting

compaction, structure and engineering behavior of compacted soil, Zero air void line, Compaction in field, suitability of various compaction equipments

Consolidation: The consolidation process, spring analogy, consolidation of laterally confined soil, Terzaghi's theory of one-dimensional consolidation (no derivation), solution of the consolidation equation, determination of coefficient of consolidation, square root time fitting method, logarithm of time fitting method, coefficient of compression, coefficient of volume change, consolidation settlement, consolidation of undisturbed specimen, determination of pre-consolidation pressure.   **Hrs-09**

Text Books:
1. V.N.S Murthy, Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers

Reference Books:
1. Alam Singh, Soil Mechanics in Theory & Practice, 12th Edition, Asia Publishing House, 2011
2. Holtz, R.D. and Kovacs, W.D, An Introduction to Geotechnical Engineering, 2nd Edition, Prentice Hall, 1981
3. Couduto, D.P., Geotechnical Engineering – Principles and Practices, 2nd Edition, Prentice Hall of India,2002
4. Ranjan, G. and Rao, A.S.R, Basic and Applied Soil Mechanics, 3rd Edition, New Age International Publishers, 2005
5. K.R. Arora, Soil Mechanics & Foundation Engineering, 5th Edition, Standard Publishers

I.S.Codes:- IS 2720- Part 1 to 41(1977)

e- Learning Resources:
> www.nptel.iitm.ac.in/iitkanpur.
> www.nptel.iitb.ac.in/iitBombay.

BCEL226 Instrumentation & Sensor Technologies for Civil Engineering Applications (Theory)
(Lectures–Tutorial–Practical-Credits) /
Week (1-0-0-1)
Marks-50 Total Hrs: 30

Course objective
1. To Understand the fundamental mechanisms of various modern analytical instrumentation
2. To Design an instrumentation circuit and analyse its properties
3. To Understand the application of sensor technologies in transportation

Course Outcome: Student shall be able to
C01 To Understand the fundamental mechanisms of various modern analytical instrumentation.
C02 Design an instrumentation circuit and analyse its properties
C03 To Understand the techniques for *Data Analysis* for modern instrumentation system
C04 Demonstrate knowledge on sensor system and usage of various sensors smart sensor system.
C05 Application of sensor technologies in transportation

Unit-I General Instrumentation measurement system: Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems. Techniques for dynamic compensation, loading effect, signal and noise in measurement system.   **Hrs-07**

Unit-II Signal Conditioning Elements in instrumentation: instrumentation amplifier, Deflection bridges: design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non inverting and differential amplifiers, and filters. A.C. carrier systems, phase sensitive demodulators, signal processing elements: A/D conversion: sampling, quantization, encoding   **Hrs-07**

Unit-III *Data Analysis and Interpretation* *:*Fundamental statistical concepts, Data reduction and interpretation, Piezometer, Inclinometer, Strain gauge, etc. Discrete signals, Signals and noise . Statistical methodology: Average value (mean), standard deviation.   **Hrs-08**

Unit-IV Smart Sensors: Introduction to fiber-optic sensors, Integrated Hall Magnetic Sensors, Inertial Sensors, liquid level sensing, fluid flow sensing, Smart Acoustic Sensors, Multi-Electrode Capacitive Sensors.

Digital Sensors: Introduction to digital encoding transducer- classification-digital displacement transducers- shaft encoder-optical encoder,   **Hrs-08**

Text Books:
1. "Measurement and Instrumentation - Theory and Application", by A. Morris & R. Langari, Elsevier 2012
2. "Instrumentation", by F. W. Kirk, T. A. Weedon, and P. Kirk, Amer Technical Pub, 5th edition, 2010
3. The Measurement, Instrumentation and Sensors Handbook", by J. G. Webster

Reference Books: (At Least 04 to 05)
1. Putten, A.F.P.V. Electronic measurement systems: theory and practice. 2nd ed. Bristol; Philadelphia: IOP Publishing, 1996. ISBN 978-0750303408.
2. Cooper W.D., Helfrick A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall of India Limited, New Delhi.
3. Meijer, G.C.M. (ed.). Smart sensor systems. Chichester, UK: J. Wiley & Sons, 2008. ISBN 0470866918.
4. Pallás Areny, R.; Webster, J.G. Sensors and signal conditioning. 2nd ed. New York: John Wiley and Sons, 2001. ISBN, 0471332321.
5. "Handbook of Modern Sensors: Physics, Designs, and Applications" by J. Fraden, Springer, 4th ed., 2010

I.S. Codes:- NA

BCEL 227 Basic Transportation Engineering & Introduction to ITS (Theory)
(Lectures) / Week (2-0-0-2)
Marks-50 Total Hrs: 30

Course objective

Course Outcome: Student shall be able to
CO1 Understand basic concept of highway engineering and intelligent transportation system
CO2 Design highway geometrics

CO3 Design flexible and rigid pavements & understand maintenance of highways

CO4 Identify factors governing railway infrastructure

Unit-I Principal of highway planning and ITS: Different modes of transportation, role of highway transportation, Classification of highways, network patterns, planning surveys, preparation of plans, final report, master plan, evaluation by saturation system, introduction to highway economics.Smart Transportation, intelligent transportation system Intelligent Traffic Management, Smart parking, Advance Safety control, Sustainable and efficient public transportation **Hrs-07**

Unit-II Highway Alignment and Geometric Design : Principles of highway alignment, requirements, controlling factors, engineering surveys, importance of geometric design, design controls and criteria, cross section elements, pavement surface characteristics, camber, carriageway, kerbs, road margins, formation, right of way, typical cross sections. Sight distance, stopping sight distance, overtaking sight distance, sight distance at intersections. Design of horizontal alignment, super elevation, transition curves. Design of vertical alignment, gradients, vertical curves. **Hrs-08**

Unit-III Materials: Sub grade soil properties, CBR test, aggregates, desirable properties, tests, bituminous materials, bitumen and tar, tests. Bituminous mixes, requirements, design, Marshall Method

Design of Pavements: Types of pavement structures, functions of pavement components, design factors. Design of flexible pavements, methods, GI method, CBR method, IRC method, Burmister's method. Design of rigid pavements, design considerations, wheel load stresses, temperature stresses, frictional stresses, design of joints, IRC method of rigid pavement design.

Maintenance of highways **Hrs-08**

Unit-IV Bridges and Railways: General Components, classification and identification, Data Collection site selection, Economic Span, IRC Specification & code of practices,. Different Structural Forms, culverts, causeway, minor and major bridges, Methods &Techniques of rating of existing bridges, Inspection, Repairs and maintenance Railways Transportation, Classification of Railways: Lines and their track standards. Railway Terminology, Permanent Way: Alignment Surveys, Requirement, gauges, track section. Rail types and functions, selection for rails, sleepers – function, types, merits and demerits, Ballast cushion, Rail fixtures and fasteners. Railway Signaling and interlocking **Hrs-07**

Text Books:
1. Khanna and Justo, Highway engineering, 8th Edition, Nemachand Bors, 2002
2. Saxena and Arora, Railway Engineering, Dhanpat Rai Publications

Reference Books:
1. Dr. L R Kadiyali, Traffic Engineering And Transport Planning, 18th Edition, Khanna publications, 2013.
2. S P Bindra, Bridge Engineering, 12th Edition, S Chand, 2002
3. C S Papacostas and P D Prevedouros, Transportation Engineering and Planning

4. P H Wright and K Dixon, Highway Engineering

I.S.Codes:-
IRC 003: 1983-Dimensions and Weights of Road Design Vehicles
IRC SP 100:2014-Use of Cold Mix Technology in Construction and Maintenance of Roads Using Bitumen Emulsion
IRC006:2014-Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses (Fourth Revision)
IRC19:2005-Standard Specifications and Code of Practice for Water Bound Macadam

e- Learning Resources:
Mitopencorsewear
https://ocw.mit.edu/courses/transportation-courses/
www.nptel.iitm.ac.in/iitDelhi.
https://www.class-central.com
Subjects › Engineering moocs

TREM –IV
BFYL109 (Mathematics VI) (Numerical Methods)

Teaching Scheme				Credits	Theory			Practical		Total	ESE Duration Hours
Th	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.		
1 H	1 H	-	2 H	2	10	15	25	-	-	50	2

Course Objectives
Students undergoing this course are expected to:
1. Learn Numerical methods to solve simultaneous equations.
2. To develop the basic understanding of numerical techniques for solving linear Differential equations.

Course Outcomes
1. Implement variety of Numerical techniques to solve various algebraic and transcendental equations.
2. Use various methods to solve Simultaneous equations.
3. Apply the knowledge of numerical techniques to solve ordinary differential equations and its applications for problems related to Civil engineering.

Course Contents
UNIT I - Numerical Methods (Equations): Solutions of algebraic and transcendental equations. Iteration method, Bisection method, False position method, Newton-Raphson method and their convergences. **08**

UNIT II- Solution of system of linear equations, Gauss elimination method, Gauss Seidel method, Crouts method **08**

UNIT III- Numerical Methods (Differential Equations): Numerical solution of ordinary differential equation by Taylor series method, Picard's method,Runga-Kutta method, Euler modified method, Milne's Predictor corrector method. **08**

Text Books
1. Higher Engineering Mathematics, Grewal B.S.: Khanna Publishers; 2013 Forty Third

Reference Books
1. Advanced Engineeing Mathematics, Kreyszig, E.John Wiley & Sons; 2000 Eight
2. Introductorymethods of Numerical analysis S. S. SastriPrentice Hall of India Pvt. Ltd., **2006** Fourth.
3. Numerical Methods, Kandasamy, P. Thilagavathy, K., and Gunavathy, S, S. Chand & Company 1998
4. Numerical Methods for Scientific and Engineering Computation Jain, M.K., Iyengar, S.R. and Jain, R.K., Wiley Eastern 1987

BCEL228: CONCRETE TECHNOLOGY
(Theory)(Lectures–Tutorial–Practical) / Week (2-0-2-4)
Marks-75 Total Hrs: 30

Course Objectives:
1. To understand the properties of concrete ingredients.
2. To study the compressive, flexural, split strengths etc and other non destructive tests.
3. To learn mix design of concrete and its application in construction work.

Course Outcome: Student shall be able to
C01 Understand Properties of cement , aggregates and water use in concrete
C02 Prepare and test the fresh concrete. Determine the Mechanical properties of hardened concrete with destructive and non-destructive testing instrument.
C03 Use various additives & admixtures of concrete, Get acquainted to concrete handling equipment and different Special concrete types.
C04 Design concrete mixes as per IS codes and to understand the durability requirements of concrete.

Syllabus
Unit-I Cement: Main constituents of cements, Hydration of cement, Water required. Physical properties,Types of cement, test on Cement,field tests & laboratory

Aggregates: Classification and nomenclature, Coarse and fine aggregate, normal weight (light and heavy weight aggregates). Aggregate characteristics and their significance in strength, workability, placement and compaction of concrete. Sampling, Particle shape and texture, Bond of aggregate, size & grading of aggregate strength of aggregate. Mechanical properties and laboratory tests – Specific gravity, bulk density, porosity, absorption of aggregate, moisture content of aggregate, bulking of sand abrasion test, impact value. Deleterious substances in aggregate, organic impurities clay and other fine material etc. Introduction of IS: 383-1970,

Water:-Water quality for mixing and curing, Acceptable water, pH value, Seawater chlorides content. Provisions in IS: 456-2000 **Hrs-07**

Unit-II Fresh Concrete: Batching, Mechanical mixers, automatic batching and mixing plants. Efficiency of mixing, Workability Measurement - Slump cone test, compacting factor test, flow table, Vee-Bee consistometer, Factor affecting workability, setting time, Significance of w/c ratio, Segregation, bleeding, voids, and permeability. placing of concrete, compaction, vibrators, methods of curing, temperature effects on curing

Strength of concrete- Factors affecting compressive strength, Tensile and flexural strengths, relation between compressive and tensile strength.

Testing of hardened concrete. Compression strength test on cubes / cylinder strength and their relation,. Flexural strength of concrete, determination of tensile strength, indirect tension test, Non Destructive test-significance, rebound hammer, ultra sonic pulse velocity test. Pullout test. **Hrs-10**

Unit-III Additives and admixtures- Types of admixtures, byproducts – pozzolans, fly ash, silica fume, rice husk ash, metakaoline, G.G. blast furnace slag, admixtures- air entraining, water reducing, accelerators, retarders, plasticizers and super plasticizers,.

Special concretes – Light weight concrete, types of fibers, fiber reinforced Concrete, high density concrete, self compacting concrete and applications. Ferrocement: Definition, Basic concepts in forming ferrocement composites, Methods of casting. **Hrs-06**

Unit-IV Mix Design- Standard deviation, factors affecting mix properties, Degree of quality control, design of mix by IS code method.

Durability of concrete- Significance, water as an agent of deterioration, permeability of concrete, air sulphate attack and control, sea water attack, acid attack, efflorescence, resistance of corrosion, abrasion and cavitations, process of rusting of steel. **Hrs-07**

Text Books:
1. M L Gambhir, Concrete Technology, 5th Edition, The McGraw-Hill Companies, 2013
2. Krishnaswamy, K.T., Kamasundara Rao, A., and Khandekar, A. A., „Concrete Technology",

Reference Books:
1. M S Shetty, Concrete Technology, 5th Edition, S Chand & Co. Ltd., 2005
2. AM Neville, Properties of concrete, 4th Edition, ELBS, London, 2012
3. Concrete Technology by R.S. Varshney, Oxford and IBH.
4. Shanthakumar A. R., "Concrete Technology", Oxford University Press, 2007

I.S. Codes
1. IS 456-2000, IS 383-1970, IS 516-1959, IS 9103-1999, IS 10262-2009

Online Certification Courses:
1. Concrete Technology, Prof. Bhattacharjee B, Indian Institute of Technology - Delhi

Best faculty members from IIT:
1. Prof. Bhattacharjee B, Indian Institute of Technology - Delhi
2. Manu Santhanam, IIT Madras

BCEP 228:CONCRETE TECHNOLOGY (Practical)
List of Practical's
Marks-25 Total Hrs: 02/Week

Course Outcome: Student shall be able to
C01 Understand Properties of cement, aggregates and water use in concrete
C02 Prepare and test the fresh concrete,Determine theMechanical properties of hardened concrete

with destructive and non-destructive testing instrument.

C03 Use various additives & admixtures of concrete,Get acquainted to concrete handling equipments and different Special concrete types.

C04 Design concrete mixes as per IS codes and to understand the durability requirements of concrete.

PR-1 To determine Fineness of cement and Standard Consistency of Cement by Vicat's Apparatus **C01**

PR-2 To determine initial and Final Setting time of given cement by Vicat's Apparatus and Soundness cement **C01**

PR-3 To determine compressive strength of cement mortar cube **C01**

PR-4 To determine Moisture content, silt content, density and Specific gravity of fine aggregate by pycnometer method **C01**

PR-5 To determine Fineness Modulus (FM) by sieve analysis of Fine Aggregate **C01**

PR-6 To determine Moisture content, water absorption, density and Specific gravity of coarse aggregate **C01**

PR-7 To determine Fineness Modulus (FM) by sieve analysis of coarse Aggregate **C01**

PR-8 To determine the Workability of Concrete by Slump Test, Compaction Factor and Vee Bee test. Effect of admixture and retarders on setting time concrete **C02, CO3**

PR-9 To determine compressive strength by rebound hammer test and ultrasonic pulse velocity test **C02, CO3**

PR-10 To determine the Flexural Strength of Concrete **C02, CO3**

PR-11 Concrete mix design by IS code method **CO3,C04**

PR-12 Site Visit to RMC Plant compulsory **C01, C02, CO3 CO4**

BCEL 230 SURVEYING & GEOMATICS (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-2-4)
Marks-75 Total Hrs: 30

Course Outcome: Student shall be able to

1. To understand the basic principles of surveying.
2. To study the coordinate systems and measuring techniques.
3. To study different types of survey and instruments used.

C01 Apply basic principles of survey for linear measurements, bearings measurements.

C02 Estimate bearings & angular measurements.

C03 Explain elevation of various points, Prepare Plan contour & topographical maps.

C04 Determine horizontal and vertical distances of points at angular observations

Unit-I Chain Traversing: Geo-informatics, Principles of Surveying, Linear measurements, Principle of Chain Surveying.

Compass Traversing: Prismatic compass, Surveyor's compass, Compass Traversing: Bearings & azimuths. Local attraction. Open & closed traverses. Adjustment of closed traverse. **Hrs-08**

Unit-II Leveling & Sectioning: Principle of leveling, Temporary& Permanent adjustments. Profile leveling, Longitudinal sectioning, Cross Sectioning, Reciprocal leveling, curvature & refraction.

Contouring: Methods of contouring. Interpolation of Contours, Computation of area and volume – Trapezoidal and Simpson's Rule, Planimeter. **Hrs-08**

Unit-III Theodolite Traversing: Temporary & Permanent adjustment, Measurement of Horizontal & Vertical angles. Consecutive & Independent Coordinates, Adjustment of Closed traverse, latitude & departure, Gale's traverse table, area calculation by coordinates. **Hrs-07**

Unit-IV Tacheomentry: Stadia method, fixed hair and movable hair and tangential method, Distance and Reduce level determination. Theory of anallatic lens, fundamental principles, **Hrs-07**

Text Books:

1. T. P. Kanetkar & S.V.Kulkarni, Surveying and Leveling Part II, 5th Edition, Laxmi Publication Ltd, 2005
2. B. C. Punmia, Surveying Vol. II and III, 5th Edition, Laxmi Publication Ltd, 2005
3. C.P. Lo, Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, 2nd Edition, Prentice Hall, 2006, ISBN-13: 9780131495029
4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004. ISBN: 978-0-471-05930-1
5. Guocheng Xu, GPS Theory, Algorithms and Applications,Publication Date: September 14, 2007 | ISBN-10: 3540727140 | ISBN-13: 978-3540727149 | Edition: 2nd

Reference Books:

1. D. Clark, Plane and Geodetic Surveying Vol II, 3rd Edition, New age international limited, 2005
2. Dr. A. M. Chandra, Surveying, 5th Edition, New age international limited, 2005

e- Learning Resources:
   www.nptel.iitrr.ac.in/iitroorki.
   www.nptel.iitg.ac.in/iitGuahati.

BCEP 230 SURVEYING & GEOMATICS (Practical)
(Lectures–Tutorial–Practical) / Week (0-0-2- 1)
Marks-25

Course Outcome: Student shall be able to

1. **CO1** Apply basic principles of survey for linear measurements, bearings measurements.
2. **CO2** Estimate bearings & angular measurements.
3. **CO3** Explain elevation of various points, Prepare Plan contour & topographical maps.
4. **CO4** Determine horizontal and vertical distances of points at angular observations

i) **PR-01** Measurement of distance by Ranging and Chaining.

ii) Locating various objects by Chain & Cross staff surveying.
   Determination of area of polygon by Chain and Cross staff survey. **CO-01**

i) **PR-02** Measurement of bearings of sides of traverse with Prismatic Compass and computation of correct included angle.

One full size drawing sheet locating given building by Chain and Compass traversing. **CO-01**

i) **PR-03** Determination of elevation of various points with dumpy level by Collimation Plane Method and Rise & Fall Method.

Determination of elevation of various points with Dumpy Level by keeping staff inverted. **CO-02**

i) **PR-04** Fixing Bench Mark with respect to Temporary Bench Mark with Dumpy Level by Fly leveling and Check leveling.

ii) One full size drawing sheet on L – section and C – section of Road.

One full size drawing sheet Contour Plan of given area. **CO-02**

i) **PR-05** Measurement of horizontal angles with Theodolite by means of Repetition Method.

ii) Measurement of vertical angles using Theodolite.

One full size drawing sheet locating given building (traverse) by Theodolite traversing. **CO-03**

i) **PR-06** Determination of constant of Tacheometer.

ii) Determination of elevation of point by Tacheometric surveying.

Determination of elevation of point and horizontal distance between them by Tacheometric survey. **CO-04**

PR-07 Topographic survey & Setting out of any building by using Total Station.**CO-01, CO-02, CO-03,**

PR-08 Open Ended Experiment. **CO-01, CO-02, CO-03, CO-04**

BCEL 231 Environmental Engineering (Theory) (Lectures–Tutorial–Practical) / Week (1-0-2-3) Marks-75 Total Hrs: 16

Course Objectives: Student shall be able to
1. Understand the concept of water supply scheme, conveyance of water and objectives of water treatment
2. Gain knowledge of water demand and water quality.
3. Learn and solve water treatment unit design problems
4. Know about water distribution system.

Course Outcome: Student shall be able to
CO1 Know the concept of water supply scheme conveyance of water and objectives of water treatment
CO2 Identify & evaluate water demand and analyze water quality.
CO3 Explain and design water treatment units for municipal use.
CO4 Choose appropriate water distribution system for a particular area.

Unit-I Introduction: Importance and necessity of water supply scheme.
Water demand: Types of demand, factors affecting per capita demand, variation in demands, design period and population forecasting methods and examples.
Sources of water, Intake structures, Rising main: Classification and design water: General idea of water borne diseases, physical, chemical, and bacteriological characteristics of water, IS 10500:2012 standards of drinking water, introduction to intake structure.
Water treatment: Objective of treatment: treatment flow sheet of conventional water treatment plant. **Hrs-05**

Unit-II Aeration : Purpose, types of aerators
Coagulation and Flocculation : Definition, principles, types of coagulants and reactions, coagulant doses, types of mixing and flocculation devices.
Sedimentation: Principles types of setting basins.
Clariflocculator : Principles and operation **Hrs-05**
Unit-III Filtration: Mechanism of filtration, types of filters RSF, SSF, pressure filters, and operational problems in filtration.
Disinfection : Purpose Mechanism , criteria for good disinfectant various disinfectants their characteristics, disinfection by chlorination using different forms of chlorine
Distribution systems : Requirements for a good distribution system, methods of distribution systems distribution systems and layouts of distribution system **Hrs-06**

Text Books:
1. S.K. Garg**,** Water Supply And Sanitary Engineering, 5th Edition, Khanna Publishers Delhi, 2010
2. B.C. Punmia, Water Supply & Sanitary Engineering, 1st Edition, Laxmi Publication, 2005
3. Dr. P.N Modi, Water supply Engineering, 3rd Edition, Rajsons Publications, 2010

Reference Books:
1. G.S. Birdie and JS. Birdie**,** Water Supply And Sanitary Engineering, 6th Edition, DhanpatRai Publishers Delhi, 2002
2. Paneerselvam .R, "Environmental Engineering", Vol. I, SPGS Publishers , Chennai – 88, 2006
3. Manual on Water Supply and Treatment," CPHEEO, Ministry of Urban, Development, Government of India, New Delhi, 2009.
IS Codes: IS 10500: 2012 Drinking Water – Specification
e-LearningResources: www.nptel.iitrr.ac.in/iitroorki& www.nptel.iitg.ac.in/iitGuahati
Online Certification Courses:
1. Water and Wastewater Treatment Engineering, Tsinghua University, China.
Best faculty members from IIT:
1. B.J.Alappat Professor in IIT Delhi

BCEP231Environmental Engineering (Practical)Total Hrs: 02/WeekMarks-25 List of Practical's

Course Outcome: Student shall be able to
CO1 Know the concept of water supply scheme and conveyance of water.
CO2 Identify & evaluate water demand and analyze water quality.
CO3 Explain and design water treatment units for municipal use.
CO4 Choose appropriate water distribution system for a particular area.
PR-1 Water Quality Standards as per IS:10500:2012 **CO1, 4**

| PR-2 | Determination of pH and Conductivity of given water sample. | **CO2** |

PR-2	Determination of pH and Conductivity of given water sample. **CO2**
PR-3	Determination of Chloride in given water sample. **CO2**
PR-4	Determination of Solids in given water sample. **CO2, 3**
PR-5	Determination of Optimum Dose of Coagulant by Jar test. **CO2**
PR-6	Determination of Alkalinity – Acidity of given water sample **CO2**
PR-7	Determination of Dissolved Oxygen of given water sample **CO2**
PR-8	Determination of Hardness of given water sample **CO2**
PR-9	Determination of Available Chlorine and Residual Chlorine in given water sample **CO2**
PR-10	Determination of BOD value for given wastewater sample. **CO2**
PR-11	Determination of COD value for given wastewater sample. **CO2**
PR-12	To perform Bacteriological Plate count and MPN tests for given water sample **CO2**

BCEL: 232 STRUCTURAL ANALYSIS (Theory)
(Lectures–Tutorial–Practical) / Week (1-1-0-2)
Marks-50 Total Hrs: 30

Course Objectives:
1. To study basic concepts of analysis of structural components.
2. To study the behavior of structural components under the various combination of loads.
3. To study various methods for the analysis of indeterminate structure.

Course Outcome: Student shall be able to
CO1 Identify the basic concept used in the analysis of Indeterminate structure.
CO2 Solve the concept of Strain energy for the analysis of different structures.
CO3 Distinguish the theories involved in the analysis of columns.
CO4 Analyzed the continuous beam with and without sinking of support, Non Sway and sway frames by different methods.

Syllabus
Unit-I Static determinacy of structure Analysis of loads on simply supported beams with concentrated and uniformly distributed loads, maximum B.M. and S.F.
Influence lines for reactions, bending moments and shear forces in simply supported beams, cantilevers and beams with overhangs.
Influence lines for forces in members of simple trusses and for BM and SF in panels of simple trusses. **Hrs-07**
Unit-II Strain energy method as applied to the analysis of redundant frames and redundant trusses up to two degrees. Determination of deflection of trusses. Willot Mohr diagram, Castiglanos theorems, Maxwell's reciprocal theorem. Batti's theorem
Hrs-07
Unit-III Bucking of Columns and beams columns, Euler's and Rankine's formula. Analysis of Two-Hinged arches , S.F. and normal thrust , parabolic arches. **Hrs-08**

Unit-IV Slope deflection method as applied to indeterminate beams & continues beams portal frames, frame with inclined legs up to 3 degrees of freedom. **Hrs-08**

Text Books:
1. S.S. Bhavikatti, Structural Analysis, Vol- I, 2nd Edition, Vikas Publication, 2009
2. Wang C.K., Intermediate Structural Analysis, 1st Edition, McGraw Hill, 2010

Reference Books:
1. Wilbur J.B. & Norris C.H, Elementary Structural Analysis, 3rd Edition, McGraw Hill, 2009
2. Theory of Structures, Stephen P. Timoshenko, Donovan H. Young, McGraw-Hill Inc.,US; 2nd edition, 1968

Online Certification Courses:
1. Structural Analysis-I, Prof. Amit Shaw, Indian Institute of Technology Kharagpur

Best faculty members from IIT:
1. Prof. Amit Shaw, Indian Institute of Technology Kharagpur

TREM V
BFYL110 Mathematics 7
(Higher order Matrices and Probability)

Teaching Scheme				Credits						Tot al	ESE Duration Hours
					Theory			Practical			
T h	T u.	Pr.	Tot al		TA E	CA E	ES E	Int.	Ext.		
1 H	0 H	-	1 H	2	10	15	25	-	-	50	2

Course Objectives
Students undergoing this course are expected to:
- Learn the various method to solve basic operations for higher order Matrices
- how to translate real-world problems into probability models.

Course Outcomes
Upon the successful completion of the course, learners will be able to
Course Outcomes
CO1 Apply the knowledge of matrices to solve the problems related to civil engg.
CO2 Apply the concept of probability and random variables in engineering field.

Pre Requisite
Higher Secondary Level Mathematics
Course Contents
UNIT I - Higher order Matrices Elementary Operations
UNIT II-Probability: Elements of probability ,Random Variables-discrete and continuous, cumulative distribution function and probability density function,
Text Books
1. Probability and Statistics Murray R.Spiegel Schaums outline series Fourth Edition 2013
Reference Books
1. Higher Engineering Mathematics B.S. Grewal.

2. Khanna Publishers2013Forty ThirdProbability and StatisticsSpiegel M. R:The McGraw-Hill Company2000Second
3. Introduction to probability and statistical applications P L MayerAddison-Wesley Publishing Company 2013Second

BCEL331 IRRIGATION AND DRAINAGE ENGINEERING (Theory)
(Lectures–Tutorial–Practical) / Week (1-0-0-1)
Marks-50 Total Hrs: 30

Course Objectives:
1. To understand the irrigation systems and its components & parameters required for planning of reservoir
2. To understand the design criteria's of all types of dams & spillways.
3. To plan the canal systems & understand the advance concepts of irrigation engineering.

Course Outcome: Student shall be able to
C01 Demonstrate an Irrigation System
C02 Plan & Design of reservoir.
C03 Plan and design diversion head works
C04 Design irrigation canal structures
CO5 Analyze gravity and earth dams

Syllabus
Unit-I Irrigation Systems: Types of irrigation systems, Soil moisture, Irrigation crop water requirements, Methods of irrigation   **Hrs-06**
Unit-II Reservoir planning: Selection of site for Reservoirs: Engineering surveys, Geological and Hydrological investigations; Fixing of LWL, FTL, HFL, TBL; Different storage zones, in reservoirs; Determination of storage capacity by mass curve method; Reservoir sedimentation; life estimation of reservoir by Brune's method; Organization & Administration of irrigation projects. Reservoir operation and scheduling.   **Hrs-05**
Unit-III Gravity Dams: Types of storage head works, Forces acting on gravity dams, Analysis of gravity dams, Profile of a gravity dam.
Earth dams: Types of earth dams, Causes of failure of earth dams, Seepage analysis, Seepage control, Stability analysis. **Hrs-09**
Unit-IV Spillways and energy dissipation systems: Types of spillways, Design of Ogee spillway, Design of stilling basins.
Design of diversion head works: Types of hydraulic structures, Layout of a diversion head work, Design of vertical drop weir, Design of sloping glacis weir. **Hrs-05**
Unit-V Canal Systems: Types of canals, Principles of design of stable irrigation canals, Silt theories, Tractive force theory, Design of lined canal, Design of longitudinal section.
Water logging. Canal regulators, Types of canal falls. Types of cross drainage works, aqueduct/ syphon aqueduct. River training work.   **Hrs-05**

Text Books:
1. Modi P.M, Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, New Delhi, 2000.

2. Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.

Reference Books:
1. Asawa G.L., Irrigation and Engineering, New Age Publishing Co., Delhi, 1996.
2. Murthy C.S.N., Water Resources Engineering – Principles and Practice, New Age Publishing Company, Delhi, 2002.

Online Certification Courses:
4. 'Irrigation and Drainage', NPTEL, Prof. Damodhara Rao Mailapallli, Professor, Department of Agricultural and Food Engineering, Indian Institute of Technology, Kharagpur

Best faculty members from IIT:
1. Dr. A K Rastogi, Professor, akr@civil.iitb.ac.in

BCEL 332:Reinforced Concrete Design (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-2-4)
Total Hrs: 30 Marks-50

Course Objectives:
1. To design RCC members of building using Limit State Design method.
2. To apply the conventional methods to design structural components of building.
3. To determine the structural behavior of rebar and concrete.

Course Outcome: Student shall be able to
C01 Demonstrate the conceptual difference between Working stress method, Ultimate load theory method & Limit state Design method.
C02 Design the structural elements like RCC beam, slab, column, and footings by limit state Design method as per I.S.456-2000.
C03 Apply the concepts of limit state of collapse in flexure and in shear and bond as per IS 456:2000. To design columns & footings for eccentric loads.
C04 Design water tanks and staircase.

Syllabus
Unit-I Introduction to working stress method of RCC design by using IS 456:2000.
Limit state Design by using IS 456:2000, Partial safety factors, load factors, stress-strain relationship, stress block parameters, failure criteria, Limit state of collapse in flexure: Design of simply supported one way single span and two way slabs using IS code coefficients.   **Hrs-08**
Unit-II Limit State of collapse in shear, Bond and Torsion, Analysis and Design of Singly and Doubly reinforced Beams, "T" beam. Design for Interaction between Bending moment, Torsional moment and Shear.
Limit state of serviceability: Deflection and moment curvature relationship, for beams and one-way slabs.   **Hrs-08**
Unit-III : Limit state of collapse under compression axially loaded short and long column, column with axial load, uniaxial moment, Interaction diagram / Charts. Design of rectangular pad/slopped footing for axial load and uniaxial bending.   **Hrs-07**
Unit-IV: Design of Dog legged Staircase.

Design of Circular and Rectangular water tank with roof slab / dome resting on ground by approximate method. (Using Working Stress Method). **Hrs-07**

Text Books:
1. Varghese P.C.; Limit state design of Reinforced Concrete Structures Prentice Hall of India, 1999.
2. Karve S.R. and Shah V.L, Limit State Theory and Design of Reinforced Concrete, Structures Publications, Pune. 2007.

Reference Books:
1. S.U.Pillai ,D.Menon: Reinforced Concrete Design, Tata Mcgraw-Hill Publishing Company New Delhi 2003.
2. Ramchandra. Limit state Design Standard Book House 1990. Bureau of Indian Standards, I.S.456-2000: Plain and reinforced concrete, Code of Practice, Bureau of Indian Standards 2000.
3. I.S.3370-1967: Part I, II and Part IV, Code of Practice for Concrete structures for storage of liquids. Bureau of Indian Standards 1967.

Online Certification Courses:
1. Design of reinforced concrete structures, Prof. Nirjhar Dhang, IIT Kharagpur (Nptel).

Best faculty members from IIT:
1. Prof. Nirjhar Dhang, IIT Kharagpur
2. Prof. A. K. Jain, IIT Delhi

BCEP 333 Building Services
(Lectures–Tutorial–Practical-Credit) / Week
(0-0-1-1)
Total Hrs: 15 Marks-25

Course Objective :

Course Outcome: Student shall be able to
C01 Understand the various concept of vastu
C02 Identify type factor and selection of building.
C03 Compute command of vastu
C04 Layout of Rooms as per Vastu Shastra
Unit-I Introduction about Vastu Concepts, Principal of Planning,Aspects of different Room **Hrs-03**
Unit-II Factor for selection of site for Residential Building, What Does Bad Vastu Cause & Good Vastu Give,Four zones ,Ten Commandments of Vastu Shastra **Hrs-03**
Unit-III Location of Doors,Ucham And Neecham, Aspect According to Vastu Shastra According to modern building science of National Building code of India rules & practice **Hrs-05**
Unit-IV Layout of Rooms as per Vastu Shastra & Modern building science. **Hrs-04**

Text Books:
1. Saral vastu Shastra vastu Shastra by Bhavan Bhaskar

Reference Books:
1. Building Design and Drawing (Shah and Kale)

IS Codes: National Building Code -16

BCEL 334Foundation Engineering
(Lectures–Tutorial–Practical) / Week (1-1-0-2)
Total Hrs: 30 Marks-50
Course Outcome: Student shall be able to

CO 1 Plan and execute the soil exploration and study various methods of ground improvement
CO 2 Perform field/lab tests on soil & Calculate the bearing capacity of soils and foundation settlements
CO 3 Analyze deep and shallow foundations
CO 4 Determine the earth pressures on foundations and retaining structures

Unit-I Soil exploration: planning, objectives and methods of exploration, soil boring, spacing and depth of boring, types of drilling, Soil investigation report
Field Tests: Plate load test, Standard Penetration test (SPT) , California Bearing Ratio test, Field Vane Shear test
Ground Improvement: Advanced methods for soil stabilization: Reinforced soil, Geo-textiles, Vibroflotation, Preloading, Grouting **Hrs-07**

Unit-II Shallow Foundation:
Bearing Capacity: Bearing capacity, its criteria, factors and various methods. Analytical Methods: Terzaghi's, Skemptons, Meyorhoff, BIS method for bearing capacity, Effect of water table, contact pressure. Bearing capacity based on plate load test results, SPT value
Settlement: Evaluation of soils settlement:Immediate, primary and secondary settlement, combined footing, concept of differential settlement **Hrs-07**

Unit-III Deep Foundation:
Pile foundation : Classification of piles and their uses, static analysis, formula for determination of pile capacity for driven and bored pile in sand and in clay, dynamic pile formula, Negative skin friction, piles in groups and their capacity, group efficiency, factors affecting group efficiency, settlement ratio, under-reamed pile
Introduction Well foundation and Raft foundation
Stress Distribution: Stress distribution in soil mass, Boussinesque's, Theory point &Uniformly loaded rectangular & circular areas, Newmarks charts.
Hrs-08

Unit-IV Slope Stability: Slopes, uses and failure of slope, stability analysis of infinite and finite slope in sand, clay and c-stability number, Swedish circle method, Friction circle method, Bishop Method
Earth Pressure: Earth Pressure at rest, active and passive, Stages of plastic equilibrium Rankin's and Coulombs theory of active and passive earth pressure on retaining wall. Influence of surcharge, water table, wall friction, Rebhann and Culmanns simple graphical methods **Hrs-08**

Text Books:
1. Dr. K.R. Arora, Soil Mechanics and Foundation Engineering, 5th Edition, Standard Publishers Distributors, 2005

Reference Books:
1. Dr. B.C. Punmia, Soil Mechanics and Foundation Engineering, 16th Edition, Laxmi Publications, 2005
2. Das B. M., Principal of Foundation Engineering, 5th Edition, Thomson Brooks/Cole, 2004
3. Bowles J.E., Foundation Analysis and Design, 5th Edition, McGraw Hill International, 1996

I.S.Codes:- IS 1892(1979), IS 2720- Part 1 to 41(1977)

e- Learning Resources:
www.nptel.iitm.ac.in/iitkanpur.
www.nptel.iitb.ac.in/iitBombay.

BCEL335 Disaster Preparedness & Planning
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
(Theory) Marks-50

Course Objective
1. To study the basic concept disaster management
2. To understand and apply the basic concepts Causes, Consequences and Control of Disasters
3. To apply scientific strategies for prepardeness

Course Outcome: Student shall be able to
C01 Apply the concept of Disaster Management.
C02 Understand Types, Trends, Causes, Consequences and Control of Disasters.
C03 Analyses risk information and early warning, Reducing the risks in key sectors.
C04 Implement emergency services, Identify the Role of Engineer in Disaster Management.

Unit-I   Understanding Disaster
Understanding the concept and definition of Disaster, Hazard, Vulnerability, Risk, Capacity-Disaster and Development and Disaster Management **Hrs-04**

Unit-II Types, Trends, Causes, Consequences and Control of Disasters
Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters Disasters (floods, cyclones, lightning, thunderstorms, hail storms, avalanches, droughts, cold and heat waves); Biological Disasters (epidemic, pest attacks, forest fire); Technological Disasters (Chemical Industries, Radiological, Nuclear) and Man made Disasters (Building collapse, rural and urban fire, road and rail accident, nuclear, radiological, chemicals and biological disasters); Global Disaster trends – Emerging Risk of Disasters – Climate change and urban disaster. **Hrs-08**

Unit-III Disaster Preparedness: Saving lives and livelihoods
Structure of the Document and Use of this Indicator and Guidance Tool, Terminology, Key terms, Guiding Principles for implementing Disaster Risk Reduction
Key Components in Preparedness Planning
Contingency Planning, Capacity Analysis and Capacity-Building, Hazard Monitoring, Forecasting and Early Warning, Information Management and Communication. **Hrs-10**

Unit-IV Readiness for Response
Emergency Services and Stand-by Arrangements, Incorporating Early Recovery into Preparedness Planning, Resource Allocation and Funding.
Study of Recent Disasters (at local, State and National Level) and Preparation of risk management plan on an area or sector. Role of Engineer in Disaster Management. **Hrs-08**

Text Books:
1. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
2. Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006

Reference Books:
1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur
4. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
5. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management

e- Learning Resources:
https://www.preparecenter.org/topics/disaster-preparedness
https://www.cdmsmith.com/en/Client-Solutions/.../10-Steps-to-Disaster-Preparedness

TREM VI
BFYL111 Mathematics 8
Optimization and Calculus of Variation

Teaching Scheme			Credits							ESE Duration
				Theory			Practical		Total	
T Th	T hu	Pr.	Total				Int.	Ext.		Hours
				TAE	CAE	ESE				
1 H	-	-	1 H	2	10	15	25	-	-	50	2

Course Objectives
Students undergoing this course are expected to:
1. Teaching of basic knowledge of Statistics
2. Learn the Linear Programming Problem
3. Learning calculus of variation and its relevance in engineering.

Course Outcomes
Upon the successful completion of the course, learners will be able to
Course Outcomes
CO1 Understand the Basics of statistics
CO2 Understand the Linear Programming Problem and will use to solve simple problems in the field of civil engineering.
CO3 Use concept of calculus of variation to solve the problems based on Functional.

Course Contents
UNIT I-Statistics: Mean median mode std deviation correlation regression
UNIT II - Introduction to optimization techniques
Linear programming, mathematical model formulation, Solutions by Graphical & Simplex method.
UNIT III - Calculus of variations:
Maxima and minima of function, variation and its properties, Euler's equation, functionals dependent on 1st and 2nd order derivatives
Text Books

Higher Engineering Mathematics, Grewal B.S.: Khanna Publishers; 2013 Forty Third

Reference Books
1. Advanced Engineeing Mathematics, Kreyszig, E. John Wiley & Sons; 2000, Eighth
2. Higher Engineering MathematicsGrewal B.S.: Khanna Publishers;2013Forty Third
3. Advanced Mathematics for Engineers and scientists Spiegel M. R McGraw-HillBook Company 2010 Second
4. Probability and Statistics Spiegel M. R: The McGraw-Hill Company 2000 Second

BCEL 336 Design of Steel Structures (Theory)
(Lectures–Tutorial–Practical-credits) / Week
(2-0-0- 2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To study the specifications in IS: 800
2. To understand the concepts and different aspects to be considered for design of steel structures.
3. To design the various structural components as per the codal provision.

Course Outcome: Student shall be able to:
C01 Understand design philosophies according to IS 800:2007 & behavior of structural steel and fasteners
C02 Design various structural components such as of steel structures using bolted& welded connections
C03 Design welded plate girders, gantry girders for the loads specified as per IS:800-2007
C04 Design laced and battened columns, columns subjected to axial & biaxial moments

Syllabus
Unit-I Structural Fasteners**:** Behavior of bolted and welded connections (types, Designations, properties, permissible stresses. Strength of bolt and strength of weld. Efficiency of joints. Design of simple bolted and welded connections. **Hrs-05**
Unit-II Design of axially loaded members Tension members, Compression members Moment resistant bolted and welded connection.(bending and torsion).Design of connection Beam to beam, beam to column-framed connection. **Hrs-05**
Unit-III Design of simple built up beams: Laterally restrained and Laterally unrestrained, Curtailment of flange plates. Design of welded plate girder, **Hrs-10**
Unit-IV Design of single rolled steel section column subjected to axial load and biaxial moment including base design. Design of axially loaded built up columns. Lacedand Battened. Column base: Design of slab Bases, introduction to gusseted bases **Hrs-10**

Text Books:
1. S. K. Duggal, Limit State Design of steel structures, 2nd Edition, Tata Mc-GRAW HILL,2013
2. Dr. V.L. Shah, Veena Gore, Limit State Design of steel structures, 3rd Edition, Structures Publications, 2012
3. N. Subramaniam, "Design of Steel Structures as per IS:800-2007", Oxford university press.

Reference Books:
1. L. S. Negi, Design of steel structures, 2nd Edition, Tata Mc-GRAW HILL, 2008

2. S.S. Bhavikatti, Design of steel structures by Limit State Method as Per IS 800-2007, 4thEdition, I.K. International Publication, 2014
3. S.K.Duggal, Design of steel structures, 3rd Edition, Tata Mc-GRAW HILL, 2009

I.S.Codes:-
IS:800-2007, IS:875-Part 1,2 & 3
NPTEL courses:
Prof. Damodar Maity, Indian IIT, Kharagpur

BCEL 337 Engineering Economics, Estimation & Costing (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-2-4)
Total Hrs: 18 Marks-100

Course Objective:
1. To write detailed specification for any Civil Engineering Structure.
2. To determine approximate and detailed estimate of Civil Engineering Structure.
3. To understand the process of tendering, valuation and economics behind it.

Course Outcome: Student shall be able to
C01 Enumerate specifications of building, irrigation, road work & methods of estimate.
C02 Estimate the quantity of Civil Engineering works.
C03 Evaluate the cost & economy of Civil Engineering aspects.

Unit-I SPECIFICATIONS: Specification of a few items related to building, Irrigation Work, Road work.
ESTIMATE OF BUILDINGS: Detailed estimation of framed structures (Residential & Commercial), Schedule of Rates. Recommendations from N.B.O. Analysis of rates. **Hrs-08**
Unit-II ESTIMATE OF OTHER STRUCTURES: Detailed estimation of Structures other than Residential & Commercial, i.e. septic tank, soak pit, sanitary and water supply, bituminous and cement concrete roads, retaining walls, culverts, irrigation works, aqueduct, siphon, fall. Schedule of Rates.
Unit-III Tenders: Tender notice and procedure.
Contracts: Type, Documentations, land acquisition act, Legal aspects of contract provisions, Arbitration. Qualification of contractor, Authenticity for public works.
Valuation: Value and cost, types, methods of valuation, valuation of old building.
Economics: Cost Accounting, classification of cost, direct & indirect charges. Net & gross return, Tenure of land, frees hold & lease holds property. Sinking fund, Depreciation, rent fixation. MAS account, issue rate of store accounts. **Hrs-05**

Text Books:
1. Dutta B.N., Estimating and Costing in Civil Engineering, Theory and Practice, 23rd Edition, UBS Publisher, New Delhi, 2003
2. Popescu C. M., Estimating Building Cost, 17th Edition, Phaobunjong Kan and Nuntapong vararin Dekker Publication, 2000

Reference Books:
1. Patil B. S, Estimating and Costing, 19th Edition, Oriental Longmans Publication, New Delhi, 2002
2. D.D. Kohali & R. C. Kohali, Text book of Estimating & Costing (Civil), 12th Edition, S. Chand, 2010

IS Codes: IS1200
e- Learning Resources:
www.nptel.iitg.ac.in/iitGuahati.

BCEP 337Engineering Economics, Estimation & Costing (Theory)
(Lectures–Tutorial–Practical) / Week (0-0-2-1)
Marks-50

Course Outcome: Student shall be able to
CO-01 Enumerate specifications of building, irrigation, road work & methods of estimate.
CO-02 Estimate the quantity of Civil Engineering works.
CO-03 Evaluate the cost & economy of Civil Engineering aspects.
PR-01 Specification for TEN items (Building works –6 items, road work –2 items, irrigation work – 2 items). **CO-01**
PR-02 Detailed estimate of a RCC G + 3 Storied Residential Building with flat roof frame type structure. **CO-01**
PR-03 Detailed estimate of a RCC G + 8 Storied Commercial Building with flat roof frame type structure. **CO-01**
PR-04 Detailed estimate of C.C. Road (Or Hot Mix Coat Road) of minimum 1 km length. **CO-01**
PR-05 Detailed estimate of any two of the following:
1. Septic tank for a colony
2. Water Supply Scheme
Earth or Water Retaining Structures
PR-06 Analysis of Rates for above mentioned Problems. **CO-02**
PR-07 Prepare DPR of buildings in PR-02 & 03 **CO-01, CO-02, CO-03,**
PR-08 Tender documents for PR-02 & 03 **CO-01, CO-02**

BCEL: 338 ADVANCED STRUCTURAL ANALYSIS (Theory)
(Lectures–Tutorial–Practical) / Week (1-1-0-2)
Marks-50

Course Objectives:
1. To understand the principals involved in the analysis of indeterminate structures
2. To study the analysis of continuous beams and frames subjected to lateral sway
3. To study approximate methods of analysis for portal frames

Course Outcome: Student shall be able to
CO1 Analyze the frames subjected to lateral sway using slope deflection method
CO2 Analyze the frames subjected to lateral sway using moment distribution method
CO3 Apply different Approximate methods for analysis of 2D frames subjected to horizontal & vertical loads
CO4 Analyze the non-prismatic sections
Syllabus
Unit-I Slope deflection method as applied to indeterminate beams & continues beams portal frames, frame with inclined legs up to 3 degrees of freedom. **Hrs-08**
Unit-II Analysis of continues beams and simple portals (Non sway) using Moment Distribution methods, Moment distribution applied to frames with sway (up to single storey two bay) **Hrs-08**
Unit-III Approximate method of Structural analysis for multi- storeyed frames with lateral loads (Portal and Cantilever method), Approximate methods for vertical loads i.e. Substitute frame method etc.(Max. three bay three storey) **Hrs-07**
Unit-IV Column Analogy method, Application to beams, Calculations of Stiffness factors and carry over factors for non-prismatic method, Analysis of non-prismatic fixed beams. **Hrs-07**

Text Books:
1. S.S. Bhavikatti, Structural Analysis, Vol- I, 2nd Edition, Vikas Publication, 2009
2. Wang C.K., Statically Indeterminate Structures, 1st Edition, McGraw Hill, New York, 1983
3. Reddy C.S, Basic Structural Analysis, 3rd Edition, Tata McGraw Hill, 2011

Reference Books:
1. Wilbur J.B. & Norris C.H, Elementary Structural Analysis, 3rd Edition, McGraw Hill, 2009
2. Theory of Structures, Stephen P. Timoshenko, Donovan H. Young, McGraw-Hill Inc.,US; 2nd edition, 1968
3. R. Vaidyanathan, P. Perumal, Comprehensive Structural Analysis, 1st Edition, Tata McGraw Hill, 2005

Online Certification Courses:
1. Advanced Structural Analysis, Prof. Devdas Menon, Indian Institute of Technology, Madras **CO-02**

Best faculty members from IIT:
1. Prof. Devdas Menon, Indian Institute of Technology, Madras

BCEL 339:Project Planning and Construction Management (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To learn elements of management in civil engineering projects, organization structure and quality control.
2. To study project planning, project monitoring, cost planning, and resource allocation through network techniques.
3. To understand engineering economics and laws related to contracts, labor safety etc.

Course Outcome: Student shall be able to
CO 1 Understand the project life cycle and organization.
CO 2 Solve problems related to Network and total duration of the project using different network techniques.
CO 3 Apply effectively the principles of economics, contracts techniques & industrial relations in projects.
CO 4 Calculate operational cost, owning and hiring cost of the equipment.
Syllabus
Unit-I Elements of Management:

Introduction, Definition, functions of management, advances and societal influences in construction management, Project life cycle, Quality control.

Phases of a project, agencies involved, Indian standards on construction and project management Stages of project planning Process of development of plans and schedules, work break-down structure role of client and contractor   **Hrs-07**

Unit-II Network Techniques & Resource Scheduling:

Bar charts, milestone charts, preparation of CPM, PERT & GERT networks, analysis of networks, Application of network Techniques.

Line of balance technique, resource constraints and conflicts, resource aggregation, allocation, smoothening and leveling   **Hrs-08**

Unit-III Engineering Economics Contract Management & Industrial Relations

Time value of money, Present economy studies, Equivalence concept, financing of projects, cash flow diagrams, evaluating alternatives by equivalence, balance sheet and profit and loss statement. Classification of costs, time cost trade-off in construction projects. Types of contracts, Legal aspects of contraction, laws related to contracts, prequalification of contracts, Elements of tender preparation, process of tendering, Evaluation of tenders, contract negotiation and award of work, Payment of wages Act, Employees State Insurance Act, Industrial safety and welfare provision. Dispute resolving techniques.   **Hrs-09**

Unit-IV Materials & equipment management

Functions and objective, procurement, Inventory control, ABC analysis & material codification. Classification, selection, operation & maintenance, depreciation & replacement cost, cost of owning of equipment.   **Hrs-06**

Text Books:
1. Chitkara K K, Construction Project Management, Tata McGraw Hill
2. Jha K N, Construction Project Management, Pearson, 2011

Reference Books:
1. Srinath L, CPM & PERT, East-West Press Pvt. Ltd New Delhi
2. S.K. Bhatnagar, Network Analysis Techniques,1st Edition, Willey Eastern Ltd., 1986

Online Certification Courses:
1. www.nptel.iitm.ac.in/iitkanpur.
2. www.nptel.iitb.ac.in/iitBombay.

Best faculty members from IIT:
1. Koshy Varghese from IIT Madras

TREM VII
BCEL 401 ADVANCED STRUCTURAL DESIGN
(Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To design of advanced structural elements like retaining walls, combined footings

2. To design doubly reinforced beam, Two way slab, biaxial column, long column.

Course Outcome: Student shall be able to

C01 Design doubly reinforced & T-beam with torsion shear and Deflection.

C02 Design of columns subjected to biaxial moments and long columns.

C03 Design Two way slab as per IS 456:2000.

C04 Design Rectangular and Trapezoidal combined footing.

C05 Design cantilever and counter-fort retaining walls.

Syllabus

Unit-I Limit state of collapse in torsion: Concept of interaction of torsion, shear and flexure. Analysis and design of doubly reinforced beam for torsion, shear and flexure.

Limit state of serviceability: Deflection calculations for doubly reinforced beam.   **Hrs-06**

Unit-II Analysis and design for columns subjected to biaxial moments. Design of long columns Hrs-05

Unit-III Design of RCC Two way slab with various end conditions using IS 456 :2000 coefficients   **Hrs-04**

Unit-IV Design of combined footing (Rectangular footing)

Design of Raft Foundation   **Hrs-08**

Unit-V Design of RCC cantilever and counter-fort retaining walls.   **Hrs-07**

Text Books:
1. Dr. B. C. Punmia, Arun Kumar Jain, Ashok Kumar Jain, Comprehensive RCC Design, 8th Edition, Laxmi Publication Pvt. Ltd., 2005
2. V. L. Shah, S. R. Karve, Illustrated Reinforced Concrete Design, 3rd Edition, Structures Publication, 1996
3. Krishna Raju," *Advanced Concrete Structures"*, McGraw Hill, New Delhi, 2000.
4. Varghese .P.C, "Advanced Reinforced Cement Concrete", Pretince-Hall India, Second edition, 2006

Reference Books:
1. James Gare, Mechanics of Material, 8th Edition, Cengage Learning, 2012
2. B. C. Punmia, Mechanics of Material, 15th Edition, Laxmi Publications, 2005
3. Gere and Timoshenko, "Mechanics of Materials", CBS publishers
4. Unnikrishna Pillai .S and Deavadas Menon, "Reinforced Concrete Design", Tata MacGraw Hill Publishing Company Limited, Second Edition, New Delhi, 2003.

Online Certification Courses:
1. Design of Reinforced Concrete Structures, Prof. Nirjhar Dhang, IIT Kharagpur. (NPTL)

Best faculty members from IIT:
1. Prof. Nirjhar Dhang, IIT Kharagpur
2. Prof. A. K. Jain, IIT Delhi

BCEL 402 ADVANCED CONCRETE DESIGN
(Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:

1. To understand the philosophies of design of reinforced cement concrete and to justify this is the best
2. To know design of advanced structural elements with safety, stability and economical way
3. To study of provisions in IS 1893 and IS 456 for design of structures

Course Outcome: Student shall be able to
CO1 Design overhead circular service reservoirs.
CO2 Design Highway Bridge Slab and Girder type as per IRC loading
CO3 Design building frames using Limit state Method
CO4 Design cylindrical shells by beam theory. Design Silos using Limit state Method.

Syllabus
Unit-I Design of overhead circular service reservoirs. Analysis of staging by cantilever method **Hrs-08**
Unit-II Design of highway bridge with IRC loading and equivalent UDL Slab type **Hrs-08**
Unit-III Design of building frames up to two bay/two storey, including design of foundation. Using Limit state Method. **Hrs-07**
Unit-IV Design of Silos and Bunkers (Using Limit state Method) **Hrs-07**

Text Books:
1. Dr. B. C. Punmia, Arun Kumar Jain, Ashok Kumar Jain, Comprehensive RCC Design, 8th Edition, Laxmi Publication Pvt. Ltd., 2005
2. V. L. Shah, S. R. Karve, Illustrated Reinforced Concrete Design, 3rd Edition, Structures Publication, 1996

Reference Books:
1. Ashok K. Jain, Reinforced Concrete: Limit State Design, 4th Edition, Nem Chand, 1993
2. T.R. Jagadeesh, M.A. Jayaram, Design of Bridge Structures, 2nd Edition, PHI Learning Pvt. Ltd., 2010

BCEL 403 Earthquake Resistant Structures (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. Geology of the Earth, Movements of Tectonic Plates, and Effects of Earthquakes
2. Dynamic Behavior of simple structural systems
3. Structural dynamics of simple systems subject to harmonic and random earthquake loading

Course Outcome: Student shall be able to
CO1 Identify movements of tectonic plates, and characterize earthquake ground shaking
CO2 Estimate the magnitude & intensity of Earthquake
CO3 Utilize the principles behind Earthquake resistant design of structures
CO4 Formulate earthquake analysis of multi-storeyed buildings
CO5 Design earthquake resistant design and ductile detailing of frame members

Syllabus
Unit-I Earth and its interior, circulations, plate tectonics, faults, seismic waves, strong ground motions, characteristics of strong ground motions, Magnitude (and Richter Scale), Intensity (and Modified Mercalli Scale) **Hrs-06**
Unit-II Earthquake Resistant Design Philosophy for Normal Buildings; Four Virtues of Earthquake Resistant Buildings – Structural Configuration, Lateral Stiffness, Lateral Strength and Ductility; Seismic Zones in India; IS Codes for Earthquake Resistant Design and Construction of Buildings; geotechnical Design Considerations and Selection of Sites **Hrs-06**
Unit-III Special aspects in Multi-storey Buildings - Open Ground Storeys, P-delta effect, Soil-Structure Interaction, Drift Limitation, Short Column Effect **Hrs-06**
Unit-IV Introduction to IS 1893 (Part 1) - 2017, Design Base Shear, Earthquake Analysis of Buildings by Equivalent Static Method **Hrs-06**
Unit-V Introduction to IS 13920 - 2016, design strategy, capacity design of RC frame members, Structural Walls and Beam-Column joints, ductile detailing in RC Beams and Columns **Hrs-06**

Text Books:
1. Pankaj Agrawal and Manish Shrikhande, Earthquake resistant Design of Structures, 3rd Edition, Prentice Hall of India Pvt, Ltd. Publications, 2006

Reference Books:
1. S. K. Duggal, Earthquake Resistant Design of Structures, 1st Edition, Oxford University PressPublications, 2007
2. Dowrick, D. L., "Earthquake Resistance Design for Engineers and Architects", 2nd Edition, John Willey & Sons, 1987

Online Certification Courses:
1. Introduction to Earthquake Engineering, Dr. R. S. Jangid, IIT, Bombay

Best faculty members from IIT:
1. Dr. CVR Murty, IIT Jodhpur
2. Dr. R. S. Jangid, IIT, Bombay

BCEL 404 Advanced Steel Design (Theory)
(Lectures–Tutorial–Practical-credits) / Week (2-0-0- 2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To understand the IS code specifications
2. Understand the design concept and able to design the components of structures
3. To identify and calculate the loads as per codal provisions

Course Outcome: Student shall be able to:
C01 Understand design philosophies according to IS 800:2007,IS:875
C02 Design Round tubular structures
C03 Design gantry girders for the loads specified as per IS code
C04 Design Foot over bridge

Syllabus
Unit-I Design philosophy & IS code recommendations. Design of connections **Hrs-05**
Unit-II Design of round tubular structures, Design of steel chimneys. **Hrs-05**
Unit-III Design of industrial gantry Girders **Hrs-10**
Unit-IV Design of Foot Bridge **Hrs-10**

Text Books:

1. S.K.Duggal, Limit State Design of steel structures, 2nd Edition, Tata Mc-GRAW HILL, 2013
2. Dr. V.L. Shah , Veena Gore, Limit State Design of steel structures, 3rd Edition,Structures Publications, 2012
3. N. Subramaniam, "Design of Steel Structures as per IS:800-2007", Oxford university press.

Reference Books:
1. L.S.Negi, Design of steel structures, 2nd Edition, Tata Mc-GRAW HILL, 2008
2. S.S. Bhavikatti, Design of steel structures by Limit State Method as Per IS 800-2007, 4thEdition, I.K. International Publication, 2014
3. S.K. .Duggal, Design of steel structures, 3rd Edition, Tata Mc-GRAW HILL, 2009

I.S.Codes:- IS:800-2007, IS:875-Part 1,2 & 3
NPTEL courses: Prof. A.Shantha Kumar, IIT, Madras
Prof.S.R.Satishkumar,IIT, Madras

BCEL 405 MATRIX METHOD OF STRUCTURAL ANALYSIS (ELECTIVE –) (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To introduce stiffness method for analysis of statically indeterminate structures.
2. To develop a computer program for structural analysis based on the matrix stiffness method
3. To understand the basics of finite element method and application to structural analysis

Course Outcome: Student shall be able to
C01 Understand the basic concept of Direct Stiffness Method for structural analysis.
C02 Understand the concept of elemental stiffness matrix for different elements.
C03 Understand the concept of global stiffness matrix for different elements.
C04 Apply the fundamental concepts in the analysis of member with temperature loading.
C05 Identify the concept involved in finite element method and application to structural analysis

Syllabus
Unit-I Basic concept, Degree of Freedoms, Basic concept of Direct Stiffness Method, Formulation of elemental / local stiffness matrix and global stiffness matrix for plain truss. Transformation Matrix, Assembly of Global/ Structure stiffness matrix up to (4X4). Member load matrix, Assembly of Global / Structure load matrix, Solution to problems with maximum degree of Freedom four.   **Hrs-07**
Unit-II Formulation of elemental / local stiffness matrix and global stiffness matrix for Beam members (without axial deformation) for continuous beams, Transformation matrix Assembly of global/Structure stiffness matrix, Member load matrix due to concentrated load, Uniformly distributed load, Moment assembly of global/ structure load matrix up to (8X8) Solution to problem with maximum degree of freedom four.   **Hrs-07**

Unit-III Formulation of elemental /local stiffness matrix and global stiffness matrix for Plane Frame member (With axial deformation), Transformation matrix, Assembly of global / Structure stiffness matrix, Member load matrix due to concentrated loads, Uniformly distributed loads, moments, Assembly of Global /Structure load matrix. Solution to plane frame problems with maximum degree of freedom six, Inclined member problem.   **Hrs-06**
Unit-IV Analysis of Member for temperature loading, initial joint displacement (sinking of support), lack of fit in trusses, trusses with inclined roller, storing of global/ structure stiffness Matrix, full storage, banded storage, band Minimization.   **Hrs-06**
Unit-V Introduction to finite Element method , basic concept, discretization of structure, Rayleigh Ritz member for bar elements (prismatic / Non prismatic) Displacement based Bar elements (prismatic / non-prismatic) and Bean elements (prismatic) Displacement based bar elements (prismatic / Non-prismatic) and Bean element (prismatic), Load,Matrix for body forces   **Hrs-04**

Text Books:
1. V. N. VaziraniM. M. Ratwani, Advanced Theory of Structures And Matrix Methods Of Analysis, 5th Edition, Khanna publisher, 2002
2. Harry H.West, Louis F. Geschwindner, Fundamentals of Structural Analysis, 2nd Edition, Wiley Publishers, 2002

Reference Books:
1. C S Reddy, Basic Structural Analysis, 3rd Edition, Tata McGraw Hill, 2011
2. Bhavikatti S S, Structural Analysis – II, 3rd Edition, VIKAS PUBLISHERS, 2009

Online Certification Courses:
1. Matrix Method of structural Analysis, Prof. Amit Show, IIT Kharagpur. (NPTL)

Best faculty members from IIT:
1. Prof. Baidurya Bhattacharya, Department of Civil . IIT Kharagpur
2. Prof. Amit Show, Department of Civil. IIT Kharagpur

BCEL 406 Repair & Rehabilitation of Structures (Theory) (Elective)(Lectures) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To Understand the Natural Causes/Agencies which Deteriorates the Structures.
2. To be Able to Understand the Role of Field Civil Engineers in Disaster Management.
3. To get the Knowledge of Techniques Available for Rehabilitation.
4. To Implement different Methods of Rehabilitation and Demolish.

Course Outcome: Student shall be able to

C01 Understand the need of Maintenance of Structures with Passage of Time.

C02 Opt proper material for Complex Situations.

C03 Come up with different techniques to Cater the Situation.

C04 Demolish the Structure in the Right Way.

Syllabus

Unit-I REPAIR STRATEGIES AND MAINTENANCE: Importance of Maintenance various aspects of Inspection. Assessment procedure for evaluating a damaged structure, causes of deterioration. Corrective & preventive maintenance of foundation as sub-structures. **Hrs-07**

Unit-II REPAIR BY DIFFERENT MATERIALS: Special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete. **Hrs-07**

Unit-III TECHNIQUES FOR REPAIR: Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. **Hrs-08**

Unit-IV REPAIRS, REHABILITATION, RETROFITTING AND DEMOLITION OF STRUCTURES: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure. Non Engineering Demolition, Mechanical Method of demolition, Dismantling of building and reuse of material and fittings. - Case studies. **Hrs-08**

Text Books:
1. Shetty M.S, Concrete Technology – Theory and Practice, 10th Edition, S.Chand and Company, 2005
2. Dov Kominetzky.M.S, Design and Construction Failures, 8th Edition, Galgotia Publications Pvt. Ltd, 2008

Reference Books:
1. Ravishankar. K., Krishnamoorthy. T. S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, 3rd Edition, Allied Publishers, 2004
2. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, 10th Edition, Narosa Publishers, 2008

Online Certification Courses:
1. SWAYAM COURSE==https://swayam.gov.in/courses/4901-july-2018-structural-health-monitoring.

Best faculty members from IIT:
1. Prof. Albert Thomas, Assistant Professor, Department of Civil Engineering, IIT Bombay; Email: albert@iitb.ac.in (Phone No. : (+91-22 25767301)

BCEL 407 ENVIRONMENTAL MANAGEMENT (Theory) (Elective-)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objective Student shall be able to
1. Gain environmental awareness.
2. Understand basic concept of environmental management
3. Know Environmental Legislation and acts.,

Course Outcome: Student shall be able to

CO1 Outline the principles of environmental management.

CO2 Understand the concept of sustainable development and Environmental Management Plan.

CO3 Apply the knowledge of Environmental Impact Assessment to real life.

CO4 The gain knowledge of environmental legislations and environmental acts.

Unit-I Definition of Environmental Management, Principles of Environmental Management, Nature, Scope and Components of Environmental Management, Policies and Legal Aspect of EnvironmentalManagement. **Hrs-08**

Unit-II Public Private Participation Model, ISO Certification, EHS, EDM. Environmental organizations for planning and implementation sustainable development. Preventive and reactive strategies for environmental pollution control. Life Cycle Assessment as Environmental Management Tool. Environmental Management Plan (EMP), Components of EMP, Preparation of EMP, Case Study **Hrs-07**

Unit-III Environmental Impact Assessment (EIA), Need and Importance, Steps involved, Methods of EIA, Ad-hoc, checklist, network, matrix etc.Typical case studies of environmental impact assessment, Environmental impact statement and risk assessment. **Hrs-07**

Unit-IV Environmental Legislation, Air, Water and Environmental acts, Preventive and reactive strategies for environmental pollution control, Environmental organization for planning and implementation, sustainable development Environmental Audit **Hrs-08**

Text Books:
1. Assessment and analysis of Environmental management, Shukla S. S., Shrivastva P. R. 1992, commonwealth publishers New Delhi 2003

Reference Books:
1. Environmental Impact Assessment, second edition, Larry W. Canter, McGraw-Hill International editions.
2. Primes on 'Environmental Management prof. P. Khanna, Multitech publications Co. New Delhi 2001.

IS Codes

e-LearningResources: www.nptel.iitrr.ac.in/iitroorki. www.nptel.iitg.ac.in/iitGuahati.

Best faculty members from IIT:
1. Dr. Shasidhar IIT Hydrabad

BCEL408 WASTE WATER ENGINEERING (THEORY) (ELECTIVE-)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To understand waste water and conveyance system.
2. To determine the physico-chemical characties of waste water
3. To provide proper arrangement and operation of units in waster water treatment plant

Course Outcome: Student shall be able to
CO1 Know wastewater treatment design and storm water, domestic sewage etc. flow system.
CO2 Explain wastewater characteristic, sampling of sewage, physical, chemical and biological characterization.
CO3 Explain and design wastewater treatment units for municipal use.
CO4 Explain low cost waste treatment.

Unit-I Introduction and objective of Waste water treatment, Quantity of storm water, domestic sewage, variation of sewage flow systems of sewerage - separate combined and partially combined layouts of sewerage system, capacity of sewers, design of sewers. Laying out of circular sewers-Boning rod and sight rail method, Testing & maintenance of sewers. **Hrs-07**

Unit-II Waste water characteristic, sampling of sewage, physical, chemical and biological characterization, B.O.D.,C.O.D., TOC, B.O.D. equation, problems on B.O.D. Pollution due to domestic and industrial waste. Sewage and Industrial effluent standards for disposal on land, into stream and into sewers. **Hrs-07**

Unit-III Treatment of sewage - purpose of treatment, preliminary treatment, primary treatment and secondary treatment. Preliminary Treatment:- Screening, Grit chamber,detritus tank., Oil and grease removal Sedimentation. **Hrs-07**

Unit-IV Biological treatment: Trickling filters, low rate & high rate tricking filters. Activated sludge process - Process description, Methods of aeration, loading rates, Different modified forms of A.S.P. design criteria using MLSS, MLVSS & SVI,F/M., Anaerobic Digestion – UASB, AFFR, Hybridreactors., biogas generation, concept of CETP **Hrs-07**

Unit-V Low cost waste treatments - Oxidation ponds, Aerated Lagoon, Treatment and Disposal ofsludge - Digestion of sludge, sludge disposal. Septic tank, working and design, Disposal of septictank effluent. Disposal of sewage on land and in stream. Self-purification capacity of stream **Hrs-07**

Text Books:
1. Rao, M. N. and Rao H. V. N., Air Pollution, 26th Edition, Tata McGraw Hill, 2007
2. Rao and Datta, Waste Water Treatment, 4th Edition, Oxford & IBH Pub. Co. Pvt.Ltd., New Delhi., 2009
3. Punmia, Wastewater Engineering, 2nd Edition, Laxmi Publication, 2005

Reference Books:
1. Matcalf and Eddy, Waste Water Treatment, Disposal and Reuse, 4th Edition, McGraw Hill Pub. Co., New Delhi, 2004

IS Codes
e- Learning Resources:
>   www.nptel.iitrr.ac.in/iitroorki.
>   www.nptel.iitg.ac.in/iitGuahati.

Online Certification Courses:
1. Water and Wastewater Treatment Engineering, Tsinghua University, China.

Best faculty members from IIT:

1. **Makarand M. Ghangrekar,** Professor, Department of Civil Engineering, Indian Institute of Technology Kharagpur
2. Dr. Debraj Bhattacharyya, Associate Professor, Environmental Engineering, Indian Institute of Technology Hyderabad.

BCEL 409 GREEN BUILDING(Theory) (Elective-) (Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objective
1. To understand the concept of high performance green buildings and sustainability.
2. To study the various existing rating systems for sustainable building design.
3. To study various methods of energy and water conservations.

Course Outcome: Student shall be able to
CO1 Gain a broad understanding of Green Building and explore the phases of sustainable development.
CO2 Apply knowledge of national and international rating systems while designing green buildings.
CO3 Apply modern green engineering concept, tools, techniques & skills necessary for engineering practice in energy efficiency concept during execution.
CO4 Explain the contemporary issues and development associated with green building.

Unit-I Introduction to Green Buildings. Impacts of building construction, operation and disposal. The green building process and assessment. Phases of sustainable development: site planning and evaluation, construction, commissioning, and occupancy phases; site selection and location of building on a site; building design: orientation, components, systems, integrated design, scale; material selection, historic, present, properties, how they work, efficiency; construction: phasing, sequencing, minimization of erosion; occupancy – proper use; reuse; building lifecycle Ecological design. **Hrs-08**

Unit-II Introduction and description of existing rating systems for sustainable building design and construction (both new construction and renovations) at local, national, and international level; BEES, LEED, CHPS, ASHRAE Green Guide, Energy Star Homes, international: BREEAM, BEPAC, Green Star Certification, CASBEE, World Green Building Council. **Hrs-07**

Unit-III Energy Considerations in Green Building. Buildings' contribution in environment devastation – why the way we build is so critical for sustainable development; electricity consumption per capita in houses. Creating a low energy profile. Building systems: lighting – day lighting; ventilation – natural ventilation; indoor air quality; heating/cooling – geothermal; passive and active systems for energy production and conservation; water conservation – grey water reuse, water saving plumbing fixtures. **Hrs-08**

Unit-IV Sustainable features in buildings – case studies of interesting items related to topic.

Construction Operations and Building Commissioning. Economic issues and future directions in green building. Proper way to promote sustainability, western world as a role model; how to stop it, motivation for conservation, marketing, tax incentives, corporate and government Environmental responsibilities **Hrs-07**

Text Books:

Reference Books:
1. Michael Bauer, Peter Mösle and Michael Schwarz, "Green Building – Guidebook for Sustainable Architecture" Springer Publication, ISBN 978-3-642-00634-0.
2. Kibert, C. J. "Sustainable construction: Green building design and delivery", Wiley, Hoboken, NJ. 2013.

IS Codes: National Building Code 2017.

e-Learnin Resources:
> www.nptel.iitrr.ac.in/iitroorki.
> www.nptel.iitg.ac.in/iitGuahati.

Best faculty members from IIT:
1. Prof. Ashish Modi, Dept. of Energy science nad Engg., IIT Bombay

BCEL 410 AIR POLLUTION & SOLID WASTE MANAGEMENT (THEORY) (ELECTIVE-)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course objective
1. Understand the terminologies & problems associated with air pollution.
2. Familiar with regulations related to air pollutions.
3. Have working knowledge of all unit operations involved in solid waste management.

Course Outcome: Student shall be able to
CO1 List the terminologies & problems associated with air pollution
CO2 Summarize various meteorological parameters, management strategies and techniques for air pollution control.
CO3 Elaborate the Solid Waste Management System also the various characteristics of solid waste.
CO4 Discuss policy regarding Transportation and Disposal of solid waste.

Unit-I   General: Air pollution episodes, local and global effects of air pollution, pollution sources and emission inventories
Thermodynamics and Kinetic:-Combustions, equilibrium calculation, chemical kinetics.
Meteorology and Transport of Air Pollution:
Wind roses, topographical effects, temperature distribution in atmosphere, inversions, plume behavior and dispersion models. **Hrs-07**
Unit-II   Air Pollution Control:
Control techniques for polluants such as particulates, sulfur oxides, nitrogen oxides, hydrocarbons etc. Noise pollution
Air Pollution Control Management:
Air quality requirements, legislation, emission standards, management for air pollution control.**Hrs-08**
Unit-III Solid Waste Management System:

Introduction, Solid waste management system and organization. Sources, types, Quantity and composition, sampling, physical, chemical and biological properties of solid waste. Collection of solid waste. Tools and equipment used. **Hrs-08**
Unit-IV Transportation & Disposal: Transportation & optimization of roots, Transfer station, volume reduction, Scientific method of disposal. Sanitary landfill, Composting, Incineration, anaerobic digestion, leachate control, Future processing method, pyrolysis, refuse derived fuel **Hrs-07**

Text Books:
1. S. Mushraf, Legal aspects of environmental pollution and its management, 1st Edition, C.B.S. publishers, Delhi, 1992

Reference Books:
1. Rao, M. N. and Rao H. V. N., Air Pollution, 26th Edition, Tata McGraw Hill, 2007
2. George Tachonobanoglous, Hilary Thesin, Samuel, Integrated Solid Waste Management, Vigil McGraw Hill

IS Codes

e- Learning Resources:
> www.nptel.iitrr.ac.in/iitroorki.
> www.nptel.iitg.ac.in/iitGuahati.

Best faculty members from IIT:
1. Khare Mukesh IIT Delhi

BCEL 411 MUNICIPAL AND INDUSTRIAL WATER TREATMENT (THEORY) (ELECTIVE-)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30   Marks-50

Course Objectives:
1. To understand the basic concept and requirement of treatment for municipal and industrial water.
2. To study theory and design of various filters
3. To study various theories and methods of adsorption

Course Outcome: Student shall be able to
CO1 Use knowledge about quality water for drinking and industry purposes,
CO2 Explain Principles of sedimentations and Filtration
CO3 Apply knowledge of adsorption and ion exchange in real life depending up to contamination in water
CO4 Apply knowledge of miscellaneous method of water treatment in real life.

Unit-I Water quality criteria and standards, requirements of water treatment facilities – unit operations and unit processes – characteristics of water.
Theory and Application aeration, Theories of chemical coagulation, common coagulant in water. Factors affecting coagulation, determination of coagulant doses, perikinetic and orthokinetic coagulation, theory and use of coagulant aids, design, construction. operation of flocculators, design of clariflocculator. **Hrs-07**
Unit-II Principles of sedimentations – effect of temperature, viscosity – efficiency short circulating – design of inlets and outlets, High rate sedimentation
Theory of filtration design construction and operation of filters – hydraulics of filtration and filter back

washing. Performance of rapid sand filters. High rate and variable rate filtration. Two layer filter pressure filters diatomaceous earth filters. Modern developments in filtration. Factors affecting disinfect ion – free and combined available chlorine, ultraviolet irradiation, ozonization disinfection of new mains – emergency chlorination. **Hrs-08**

Unit-III Water treatment for swimming pools.

Theories of adsorption. Freundlich equation. Removal of taste and dour by adsorption. Activated carbon phenol value. Other method of taste and odour control and colour removal. Boiler, cooling and other industrial water requirements. Langelier index. Softening of water **Hrs-07**

Unit-IV Lime – soda methods. Dosage control. Excess dose. Hot lime – soda. Split treatment. Recarbonation. Use of polyphosphates Softening by ion exchange. Natural and synthetic media, capacity, regeneration. Ion exchange demineralization. Miscellaneous method of water treatment, iron and removal, desalination, nitrate, phosphate and arsenic removal and recent advances. **Hrs-08**

Text Books:
1. S.K. Garg, Water Supply And Sanitary Engineering, 5th Edition, Khanna Publishers Delhi, 2010
2. N.J.Mcghee, Water supply and sewerage, 1st Edition, Tata McGraw Hill, 1991
3. B.C. Punmia, Water Supply & Sanitary Engineering, 1st Edition, Laxmi Publication, 2005

Reference Books:
1. Matcalf and Eddy, Waste Water Treatment, Disposal and Reuse, 4th Edition, McGraw Hill Pub. Co., New Delhi, 2004
2. N.J. Weber, Physicochemical process for water quality control, 3rd Edition, John wiley and sons, 1972
3. Nordel, E, Water treatment for industrial and other uses Vol 42nd, 5th Edition, Reinhold Publishing Corporation 2007

e- Learning Resources:
> www.nptel.iitrr.ac.in/iitroorki.
> www.nptel.iitg.ac.in/iitGuahati.

Best faculty members from IIT:
1. B. J. Alappat   Professor in IIT Delhi
2. Dr. Debraj Bhattacharyya, Associate Professor, Environmental Engineering, Indian Institute of Technology Hyderabad.

BCEL 412 Advanced Fluid Mechanics (Theory)(Elective)
(Lectures) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To provide basic knowledge for free surface flow
2. To introduce the concepts of channel hydraulics.
3. To Use in design of inland waterways for irrigation and navigation.
4. To Introduce the Concepts of Gradually Varied Flow and Hydraulic Jumps.

Course Outcome: Student shall be able to

C01 Identify properties of fluid for free water surface.

C02 Use Concepts of Specific Energy and Specific Force

C03 Use concept for hydraulic jump and apply governing equation for GVF.

C04 Apply flow measurement in open channels.

Syllabus

Unit-I Introduction to Free Surface Flows : Comparison between pipe and channel flows, basic equations governing channel flows.

Uniform Flow : Flow resistance in channel flows, resistance relationships, normal depth, section factor for uniform flow computation

Unit-II Concepts of Specific Energy and Specific Force : Section factor for critical flow computation, critical depth computations, control sections, applications of specific energy and critical depth. **Hrs-06**

Unit-III Gradually Varied Flow : Governing equations, characteristics and classification of water surface profiles, computations of GVF profiles in prismatic and non-prismatic channels.

Hydraulic Jump : Types of jump, hydraulic jump in horizontal rectangular channels, forced jump, hydraulic Jump in non-rectangular and sloping channels, stilling basins. **Hrs-08**

Unit-IV Flow Measurement in Open Channels : Broad and sharp-crested weirs, free overall, flow over spillways, side weirs, sluice gates. **Hrs-08**

Text Books:
1. R. K. Bansal, A Textbook of Fluid Mechanics, Laxmi Publications, 2008 (First Edition)
2. V.L. Streeter and E.B. Wylie, Fluid Mechanics, McGraw Hill, 1997.
3. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics, Standard Book House, 1998.

Reference Books:
1. B.F. White, Fluid Mechanics, McGraw Hill, 1994.
2. K S. Massey, Mechanics of Fluids, Van Nostrand Reinhold Co., 1979.
3. J. Frabzini, Fluid Mechanics with Engineering Applications, McGraw Hill, 1997.
4. J.H. Spurk, Fluid Mechanics – Problems and Solutions, Springer, 2003.

Online Certification Courses:
1. SWAYAM COURSE= https://swayam.gov.in/course/4505-advanced-fluid-mechanics
2. NPTEL COURSE= https://onlinecourses.nptel.ac.in/noc18_me10/preview

Best faculty members from IIT:
1. **Dr. Abhijit Guha,** Ph.D., University of Cambridge, Professor.

BCEL413 GROUND WATER MANAGEMENT (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To Know groundwater availability and domains; recharge
2. To Introduce to Ground Improvement techniques.
3. To improve ground water table techniques

Course Outcome: Student shall be able to

C01 Know about ground water availability zones and ground water management.

C02 Analyze and suggest proper ground improvement technique for problematic ground conditions.

C03 Apply the knowledge of ground water availability with proper understanding and for natural resources for sustainable development

C04 Explain the ground water movement phenomenon

CO5 Understand the ground water recharge methods

Syllabus

Unit-I Geohydrology: Rocks as aquifers, occurrence and availability of Groundwater; Groundwater investigations, groundwater development and management in India; Techniques of groundwater recharge. **Hrs-06**

Unit-II Groundwater: Introduction, Occurrence and distribution of Groundwater, Water table. Introduction to hydraulics of wells, Open wells - yield test. **Hrs-05**

Unit-III Applications of Geoinformatics for spatial management of resources: Run-off estimations, infiltration characteristics, groundwater potential and recharge characteristics, Watershed management, watershed prioritization, Sediment yield estimation, reservoir capacity studies **Hrs-09**

Unit-IV Ground Water movement: Darcy's law, permeability and its measurement, tracing of ground water movement, fundamental equations for steady and unsteady ground water flow, flow nets. **Hrs-05**

Unit-V Ground- water replenishment, recharge of ground water, different methods **Hrs-05**

Text Books:
1. KVGK Gokhale, Principles of Engineering Geology, BS Publications.
2. David Reith Todd, Groundwater Hydrology John Wiley publishers 2002.

Reference Books:
1. Geographic Informaiton System and Enviornment Modeling, Keith C. Clerk, Bradely O.Parks, Michel P Crane, Pritince Hall of India, 2002.
2. Ragunath H M Groundwater & Well Hydraulics , Wiley Eastern Ltd, New Delhi 2000

Online Certification Courses:
1. Ground Water Hydrology by Dr Rajib Kumar Bhattacharjya,rkbc@iitg.ernet.inDept. of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati - 781039, Assam, India https://nptel.ac.in/courses/105103026/

BCEL414: Advanced Hydraulics Engineering (Theory)(Elective)
(Lectures) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To provide basic knowledge for the Flow in Open Channel.
2. To introduce the concepts of Uniform Flow and Varying Flow.
3. To utilize the knowledge of flow in Non-Prismatic Channels.

To Introduce the Working of Turbines.

Course Outcome: Student shall be able to

C01 Determine the type of Flow in channel.

C02 Differentiate between the types of Flow taking place in Channel.

C03 Draw the Various Flow Patterns in any Open Channels.

C04 Explain the Working of Turbines and Pumps.

Syllabus

Unit-I Open Channel Flow: Kinds of open channel flow, channel geometry, types and regimes of flow Velocity distribution in open channel, wide open channel, specific energy, critical flow and its computation Energy in non-prismatic channel, momentum in open channel flow, specific force.**Hrs-07**

Unit-II Uniform Flow: Qualification of uniform flow, velocity measurement, Manning's and Chezy's formula, determination of roughness coefficients Determination of normal depth and velocity, most economical sections, non-erodible channels Flow in a channel section with composite roughness, flow in close conduit with open channel flow.

Varied Flow: Dynamic equations of gradually varied flow, assumptions and characteristics of flow profiles, classification of flow profile, draw down and back water curves profile determination, graphical integration, direct step and standard step method, numerical methods, flow through transitions, dynamic equation of spatially varied flow Analysis of spatially varied flow profile, computation of spatially varied flow using numerical integration. **Hrs-09**

Unit-III Hydraulic Jumps: Hydraulic jump, types of jump, basic characteristics of jump, length and location of jump, jump as energy dissipation, control of jump, surges, surge channel transitions.

Flow Through Non-Prismatic Channel Section: Sudden transition, sub-critical flow through sudden transition, flow through culverts, flow through bridge piers, obstructions, and channel junctions. **Hrs-07**

Unit-IV Turbines: Application of momentum principle, impact of jets on plane and curved plates, turbines, classification, radial flow turbines Axial flow turbines, impulse and reaction turbines, draft tube and cavitation, performance of turbines, centrifugal pump, minimum speed to start the pump Multistage pumps, jet and submersible pumps, positive displacement pumps, reciprocating pump, negative slip, flow separation conditions. **Hrs-07**

Text Books:
1. K. Subramanya: "Flow in open channels". Tata McGrawm Hill (1997)
2. Terry Sturm, Open Channel Hydraulics, MG Hill Publications

Reference Books:
1. V.T. Chow: "Open-channel hydraulics." McGraw Hill Publications (1959,1973)
2. Rajesh Srivastava: "Flow through open channels". Oxford University Press (2008)
3. H. Chaudhury: "Open channel flow". Second Edition. Springer (2008)

Online Certification Courses:
1. **SWAYAM COURSE==**https://swayam.gov.in/course/3736-computational-hydraulics
2. **NPTEL COURSE==** https://nptel.ac.in/courses/105103021/

Best faculty members from IIT:

1. Dr. Kamlesh Kumar Pandey, Associate Professor, IIT Bhubaneswar, (kkp.civ@iitbhu.ac.in)

BCEL 415: Soil Dynamics (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To understand the basics of soil dynamics.
2. To study the soil dynamic properties of soil.
3. To use the fundamental concepts for design of foundation in different conditions.

Course Outcome: Student shall be able to
C01 familiar with identification and solution of a particular dynamic system.
C02 analyze dynamic behavior of soil through wave propagation theory and also be able to determine the dynamic soil properties.
C03 analyze and carry out the design of machine foundation.
C04 provide appropriate vibration isolation technique if necessary.

Syllabus
Unit-I   Introduction to Soil Dynamics:
Theory of vibration, Dynamics Systems, single degree and two degree of freedom system, vibration of six and multi degree freedom system, Mass spring analogy - Barkan's Theory, Vibration Isolation: Introduction, Active and passive isolation, Methods of vibration isolation   **Hrs-06**
Unit-II Wave Propagation:
Wave propagation theory and its application to dynamic problems   **Hrs-06**
Unit-III Soil Dynamic Properties:
General factors affecting shear modulus, elastic modulus and elastic constants, Field Techniques – Cyclic plate load test, block vibration test, Standard Penetration Test, Seismic bore hole surveys, Laboratory techniques – Resonant column test, Cyclic simple shear and triaxial compression test Problems   **Hrs-09**
Unit-IV Machine Foundations:
General principles of machine foundation design, Types ofmachines and foundations, General requirements of machine foundation, Permissible amplitudes and stresses.

Text Books:
1. Vibration Analysis and Foundation Dynamics by N.S.V, Kameswara Rao, published by Wheeler publishing
2. Analysis and Design of Foundation for Vibration by P.J. Moore published by Oxford and IBH Publishing Company

Reference Books:
1. Soil Dynamics and Machine Foundations by Swami Saran
2. Vibration of Soil and Foundation by F.E. Richart, J.R. Hall and R.D. Woods Published by Prentice-Hal Inc, New Jersy
3. Soil Dynamics and Machine Foundation by Swami Saran published by Galgotia Publication

Online Certification Courses:
1. SWAYAM course IIT kharagpur
Best faculty members from IIT:
1. Dilip Kumar Baidya

BCEL 416: PAVEMENT DESIGN (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To study latest methods of analysis and design of flexible and rigid pavements including its maintenance
2. To understand the behaviour of different pavement materials
3. To predict stresses developing in flexible and rigid pavements

Course Outcome: Student shall be able to
CO1 Characterize the response characteristics of pavement materials
CO2 Analyse flexible and rigid pavements
CO3 Field testing and evaluation of pavements
CO4 Design and maintain flexible and rigid pavements using IRC and AASHTO methods

Syllabus
Unit-I   Pavement Materials :Types and component parts of pavements, highway and airport pavements, Materials used in pavements, basic soil properties relevant to pavement applications, resilient modulus, and modulus of sub-grade reaction, **Physical properties** :Aggregates and blending, Basic properties of bitumen, polymer and rubber modified bitumen, Dynamic modulus, flow time and flow number of bituminous mixes. Cement: chemical composition, types, physical properties.   **Hrs-06**
Unit-II Stresses in flexible pavements: layered system concepts, stress solution for one, two and three layered systems, fundamental design concepts.
Stresses in rigid pavements: Westergaard's theory and assumptions, stresses due to curling, stresses and deflections due to loading, frictional stresses, stresses in dowel bars and tie bars.
Factors Affecting Pavement Design: Variables considered in pavement design, Classification of axle types, articulated commercial vehicles, legal axle and gross weights on single and multiple units, tyre pressure, contact pressure, ESWL, EWLF and EAL concepts, Traffic analysis: ADT, AADT, growth factor, lane distribution, directional distribution and vehicle damage factors.   **Hrs-09**   **Hrs-09**
Unit-III Pavement testing and evaluation : Field Density, CBR, Plate load Test, Condition surveys and surface evaluation for unevenness, rut depth, profilometers, Bump integrators, Benkalman Beam Deflection study.   **Hrs-05**
Unit-IV Design of Pavements: IRC method of flexible pavement design, Design of flexible pavements for low volume roads using IRC method, IRC methods of rigid pavement design, Design of rigid pavements for low volume roads using IRC method.
Strengthening of pavements: Repairs, Maintenance and rehabilitation of pavements.   **Hrs-05**

Text Books:
1. Khanna & Justo, Highway Engineering, 10th Edition, Nem Chand Brothers,
2. Huang, Y.H. Pavement Analysis and Design, Second Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi, India, 2008
Reference Books:

1. David and Paul Croney, Design and performance of road pavements, 3rd Edition, Mc Graw hill, 1998

IS Codes:
1. IRC: 37-2012 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi, India, 2012.
2. IRC: 58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways,The Indian Roads Congress, New Delhi, India, 2011.
3. IRC: SP: 62-2004 Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads, The Indian Roads Congress, New Delhi, India, 2004.

Online Certification Courses:
1. www.nptel.ac.in.

Best faculty members from IIT:
1. Prof. Avijit Maji – IIT Bombay
2. Prof. Animesh Das- IIT Kanpur

BCEL 417: ADVANCED TRANSPORTATION ENGINEERING (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To introduce the advances in transportation engineering and to make the students conversant with traffic flow theory as well as analytical techniques in estimation of flow variables
2. To understand traffic safety, causes of accidents, interpreting accident data.
3. To understand the concepts of air transportation, including air traffic control and operation, and runway configuration and length

Course Outcome: Student shall be able to
CO1 Measure and calculate different traffic parameters like speed, flow, travel time and delay.
CO2 Apply appropriate statistical methods while dealing with different types of traffic data collected during traffic studies and must have a understanding of measures for traffic safety.
CO3 Carryout the geometrical design of the airport infrastructure
CO4 Implement different visual aids required at airport

Syllabus
Unit-I Objective and scope of traffic engineering, intelligent transport, tunnel, and airport engineering. Traffic Engineering: 3E's of traffic characteristics, road vehicle characteristics, Traffic on Indian roads. Traffic surveys: Speed, Journey time and delay studies, methods of measurement of spot speed headways gaps volume/ capacity surveys speed, volume density interrelations, measurements of running and journey speeds Origin Destination surveys necessity, surveys necessity, survey methods sample size, data analysis & Presentation, Highway capacity, level of service concepts. Traffic Flow measurement and automatic incident detection using video camera. Collision avoidance system. **Hrs-08**
Unit-II Traffic Events:StatIstical method for interpretation regression application of Binomial, Normal Poission distributions, Discrete and continuous distribution to traffic flow, Test of significance – Chisquare & 'T' testTraffic Safety:
Driver error, vehicle & road surface Laws and enforcement traffic accident conditions in India Collection and interpretation of accident data and recording in Std. from skidding sped and weather effects on accidents, Analysis of accidents. Pedestration cyclist & auto vehicle driver's safety. Traffic regulation 3R and 5E's of traffic management. Traffic signal control system. Dynamic traffic light signals. **Hrs-08**
Unit-III Development of Air Transportation in India: Comparison with other transportation modes. Aircraft components and characteristics, Airport site selection. Modern aircrafts.
Airport obstructions: Zoning laws, Imaginary surfaces, Approach and Turning Zone, clear zone, Vert. Clearance for Highway & Railway.Runway And taxiway design: Windrose, cross wind component, Runway Orientation and configuration. Basic runway length and corrections, runway geometric design standards. Taxiway layout and geometric design standards. Exit Taxiway **Hrs-07**
Unit-IV Airport layout, Airport classification. Terminal Area, Aircraft parking and parking system. Unit Terminal concept, Aprons, Hangers, International Airport layouts, phase development, helipads and heliports.Visual Aids: Airport marking and Lighting for runway, Taxiway and other areas.Air traffic control: Need, Network, control aids, Instrumental landing systems, Advances in Air-traffic control. **Hrs-07**

Text Books:
1. S.K.Khanna, C.E.G. Justo, Highway Engineering, 8th Edition, Nem Chand & Bros, Roorkee, 2001

Reference Books:
1. Rangwala, Highway Engineering, 3rd Edition, Charotar Publishing House, 2004
2. L.R Kadiyali, Traffic Engineering And Transport Planning, 3rd Edition, Khanna Book Publishing, 2014

IS Codes:
1. IRC: 37-2012 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi, India, 2012.
2. IRC: 58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, New Delhi, India, 2011.
3. IRC: SP: 62-2004 Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads, The Indian Roads Congress, New Delhi, India, 2004.

Online Certification Courses:
1. www.nptel.ac.in.

Best faculty members from IIT:
1. Prof. Avijit Maji – IIT Bombay
2. Prof. Animesh Das- IIT Kanpur

BCEL 418: Urban Transportation Planning (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To understand the basics principles of transportation.

2. To study the urban transportation planning & processes.
3. To use the laboratory concepts for solving the problems related urban transportation.

Course Outcome: Student shall be able to
C01 model a new Traffic Plan of its own.
C02 decide the traffic system and Forecasting.
C03 Assess the system characteristics and Network.
C04 Design the Traffic Network for the proposed Routes.

Syllabus

Unit-I Introduction and scope; Definition and basic principles; Transportation problems; Types of models; Planning methodologies; Conventional transportation planning process; Travel demand modelling andforecasting; **Hrs-06**

Unit-II Urban Transportation Planning Process, Urban Travel and Transportation Systems Characteristics, Travel Demands Forecasting- trip generation, trip distribution, modal split and trip assignment. **Hrs-08**

Unit-III Transport Behavior of Individuals and Households, Land use/ Transportation systems, ; Traffic Assignment - route building, capacity restraint, multipath, incremental and equilibrium assignment; Graph theory applications in transport network analysis; **Hrs-08**

Unit-IV Laboratory Component: Solving case study problems in travel demand modelling with the help of transportation planning and econometric packages. Developing computer programs for the calibration of travel demand, land-use and land use-transport models. **Hrs-08**

Text Books:
1. Hutchinson, B.G., Principles of Urban Transport Systems Planning,McGraw Hill, New York, 1974.
2. Ortuzar, J. and Willumsen, L.G., Modelling Transport, Wiley, Chinchestor, 1994.

Reference Books:
1. Oppenheim, N., Urban Travel Demand Modeling: From Individual Choices to General Equilibrium, Wiley, New York, 1995.
2. Thomas, R., Traffic Assignment Techniques, Avebury Technical, Aldershot, 1991.
3. Bruton, M.J., Introduction to Transportation Planning,

Online Certification Courses:
1. https://nptel.ac.in/courses/105107067/
2. Swayam course by School of Planning & Architecture

BCEL 419 DEPARTMENT ELECTIVE – ADVANCED SURVEYING (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0- 2)
Total Hrs: 18 Marks-50

Course Objectives:
1. To classify the various elements of curves
2. To understand the errors in trangulation and calculate base line.
3. To understand the various components of GPS and GIS and calculate heights in photogrammetry.

Course Outcome: Student shall be able to

C01 Take linear measurements, bearings measurements.
C02 Calculate elevation of points & Prepare contour & topographical maps.
C03 Take angular measurements.
C04 Determine horizontal and vertical distances of points at angular observations

Unit-I Curves: Classification & Elements, Setting of curves. **Hrs-08**

Unit-II Triangulation: Classification, figures, choice of station, phase of signals, towers, satellite station, reduction to center, field work, Reconnaissance, Indivisibility, angular measurement. Base line measurement and corrections, Base-net, extension of Base-net, errors in observation and adjustment, method of least square, weighted observation, figure adjustment (Triangle only), Trigonometric leveling, Axis single corrections. **Hrs-08**

Unit-III Element of Photogrammetry: - Basic definition, terrestrial and aerial photography, scale of vertical photograph, Relief and relief displacements, height from parallel measurements, fights planning, photographs required, Applications of aerial Photos.

Field Astronomy: Elements of spherical trigonometry, Napier's rules of circular parts, celestial sphere, ecliptic, circumpolar stars, astronomical terms, Astronomical triangle ,co-ordinate systems. **Hrs-07**

Unit-IV Remote sensing : Introduction ,definition, remote sensing system, advantages over conventional system, energy interaction in the atmosphere ,Indian remote sensing satellite series and their characteristics.

GIS & GPS: Components of geographical information system (GIS), advantages and disadvantages, global positioning system (GPS), Introduction, definitions, GPS receivers, antenna, advantages of GPS.

Hydrographic Surveying: necessity, controls, shore line surveys, gauges, sounding equipments and procedure of taking soundings, method of location of sounding, three point problem in hydrographic surveying, analytical and graphical methods, station pointer.

Underground Surveying: Surface alignment, correlation of surface and underground surveys; weisbach triangle, transferring levels underground. **Hrs-07**

Text Books:
1. T. P. Kanetkar & S. V. Kulkarni, Surveying and Leveling Part II, 5th Edition, Laxmi Publication Ltd, 2005
2. B. C. Punmia, Surveying Vol. II and III, 5th Edition, Laxmi Publication Ltd, 2005
3. C.P. Lo, Albert K. W. Yeung, Concepts and Techniques of Geographic Information Systems, 2nd Edition, Prentice Hall, 2006, ISBN-13: 9780131495029
4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004. ISBN: 978-0-471-05930-1
5. Guocheng Xu, GPS Theory, Algorithms and Applications, Publication Date: September 14, 2007 | ISBN-10: 3540727140 | ISBN-13: 978-3540727149 | Edition: 2nd

Reference Books:

1. D. Clark, Plane and Geodetic Surveying Vol II, 3rd Edition, New age international limited, 2005
2. Dr. A. M. Chandra, Surveying, 5th Edition, New age international limited, 2005

e- Learning Resources:
www.nptel.iitrr.ac.in/iitroorki.
www.nptel.iitg.ac.in/iitGuahati.

BCEL 420 GIS AND Remote sensing (Elective)
(Lectures–Tutorial–Practical) / Week (2-1-0-0)
Total Hrs: 30 Marks-50

Course Objectives:
1. To study the data structure and learn history of GIS
2. To provide applications of GIS and basic concepts of photogrammetry.
3. To use GIS/GPS in Transportation, Real World Experiences

Course Outcome: Student shall be able to
C01 Define GIS, type of data and data structure and learn history of GIS
C02 Apply various commands for special analysis such as query, overlay and data analysis
C03 Understand the applications of GIS and basic concepts of photogrammetric
C04 To learn the concept of remote sensing, element, passive and active remote sensing
CO5 To understand GIS/GPS in Transportation, Real World Experiences

Syllabus

Unit-I GIS Definition – Map and map analysis – Automated cartography – History and development of GIS – Hardware requirement – Type of data – Spatial and non- spatial data – Data structure – Vector and raster – Files and data formats – Data compression.
Hrs-06

Unit-II Spatial analysis – Data retrieval – Query – Overlay – Vector data analysis – Raster dataanalysis – Modelling in GIS – Digital Elevation Model – DTM – Types of output data –Output devices – Sources of errors – Types of errors – Elimination – Accuracies
Hrs-05

Unit-III The Global Positioning system and its applications. Concepts and foundations of remote sensing - electromagnetic spectrum - EMR interaction with atmosphere, water vapour, ozone - Basic principles of photogrammetry – Spectral Signature and Spectral Signature curves
Hrs-09

Unit-IV Remote sensing platforms and sensors.Satellite system parameters, sensor parameters, earth resources and meteorological satellites,microwave sensors, Data Acquisition and interpretation - Visual Image Interpretation – Visual Image Interpretation Equipment
Hrs-05

Unit-V Digital Image Processing – Classification.Applications in Survey, mapping and monitoring of land use/land cover – Transportation planning - Infrastructure development - Natural resources management - Urban Planning,Environment - Coastal Zone Management – Air Quality - Development of Resources Information Systems.
Hrs-05

Text Books:

1. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004.
2. C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice-Hall India, 2006.

Reference Books:
1. Thomas. M. Lilles and and Ralph. W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 2003.

Online Certification Courses:
1. GIS AND Remote sensing Dr Arun kumar sarf IIT Roorkee.

Best faculty members from IIT:
1. Dr Arun kumar sarf IIT Roorkee.

Reference Books-
1. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, OxfordPublication, 2004.
2. C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice-Hall India, 2006.

BCEL 421: Operation Research and Management (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. To study operational research methodology and its application to engineering.
2. To introduce students to use quantitative methods and techniques for effective decisions–making.

Course Outcome: Student shall be able to
C01 Apply Operation Research methodology to solve industrial problems.
C02 Formulate and convert the real world problem into a mathematical form and provide an optimum solution for implementation.
C03 Apply the concept and knowledge of project management and able to build the network and analyze it for improvement in project or task.
C04 Use the inventory and simulation tools to give creative solutions.

Syllabus

Unit-I Introduction & Linear Programming:
Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study.
Two variable Linear Programming model andGraphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis
Hrs-06

Unit-II Transportation Problems:
Types of transportation problems, mathematical models, transportation algorithms, Allocation and assignment problems and models.

Inventory
Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipment's that deteriorate with time, equipments that fail with time.
Hrs-08

Unit-III Project Management & Network Techniques

Phases of project management, guidelines for network construction, CPM and PERT, Shortest path model, minimum spanning Tree Problem, Max Flow problem and Min cost problem. **Hrs-09**

Unit-IV Theory of Games & Quality Systems
Rectangular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Elements of Queuing model, generalized poison queuing model, single server models. **Hrs-07**

Text Books:
1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.
2. Hamdy H. Taha, "Operations Research- An Introduction" Pearson Education,2003.
3. R. Panneerselvam, "Operations Research" PHI Learning, 2008.

Reference Books:
1. Operation Research by Hira & Gupta
2. Operation Research by J.K. Sharma
3. Operation Research by Ashkhedkar & Kulkarni

BCEL 422: NEW ENGINEERING MATERIALS & TECHNIQUES (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30   Marks-50

Course Objectives:
1. To study the mix design of concrete and fibers reinforced concrete.
2. To study the strain gauges static and dynamics strain measurement.
3. To understand the modern methods used in various construction works.

Course Outcome: Student shall be able to
CO1 Understand concrete mix design and validation as per project needs
CO2 Summaries the fibers reinforced concrete and their applications
CO3 Understand the importance of Light weight concrete, foam concrete on modifying fresh, hardened and durability properties of concrete
CO4 understand the importance of construction chemicals(admixtures) on properties of concrete

Syllabus
Unit-I Study of Indian standards and there specification for concrete ingredients, Principles of concrete mix design, methods of concrete mix design, design of high strength, high performance concrete, Steel fibers reinforced concrete, Properties, Aspect ratio, strength, Durability of fiber reinforced plastics, other types of fibers and their applications.
Concrete admixtures, accelerators, retreads, non-destructive testing and quality control of materials
Unit-II Stress-strain measurement, strain gauges static and dynamics strain measurement, Calculation of stresses from measurement of strain, deflections etc
Unit-III Light weight concrete, foam concrete, workability, durability, and composition, application, Fly ash blended concrete, replacement procedures, effect of admixtures, adhesives, bond strength, durability, applications **Hrs-07**
Unit-IV Modern trends in concrete manufacturing, placement techniques, methods of transportation, placing of concrete, Industrial waste materials in concrete, their influence on physical mechanical properties of concrete and durability of concrete

Text Books:
1. AM Neville, Properties of concrete, 4th Edition, ELBS, London, 2012

Reference Books:
1. M L Gambhir, Concrete Technology, 5th Edition, the McGraw-Hill Companies, 2013
2. M S Shetty, Concrete Technology, 5th Edition, S Chand & Co. Ltd., 2005
3. IS: 13925 Repairs and Seismic Strengthening of Buildings-Guidelines" Bureau of Indian Standard New Delhi-1984
4. SP: 25 Causes and Prevention of Cracks in Buildings, Bureau of Indian Standard, New Delhi.

BCEL 423: Earth & Earth Retaining Structure (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1. Slope stability analysis of Earthen Embankment, and Design of Earth Retaining Wall
2. Design of Earth Retaining Structures for Soils with different properties

Course Outcome: Student shall be able to
CO1 Identify different types of retaining walls
CO2 Estimate lateral earth pressure for design of retaining walls
CO3 Analyze and design simple retaining walls with basic analytical skills
CO4 Analyze and design complex retaining walls
CO5 Identify appropriate methods of analysis, design and construction of earth retaining walls

Syllabus
Unit-I   Earth Pressure Retaining Walls
Rankines & Coloumb's earth pressure theories; Poncelets and Culman's graphical construction for active and passive pressures; Effects of wall movement, Wall friction, type of slip surface; Wall angle, backfill slope angle, surcharges & line loads on lateral earth pressure; Direction and point of earth force application **Hrs-06**

Unit-II Stability of Earth Retaining Structures
Types of Walls: gravity, cantilever walls, walls with counterforts and relief shelves, their typical dimensional details; Stability requirements for overtaking, sliding, bearing capacity failure, and overall stability against shear failure in backfill & foundation soil; application of geosynthetics in earth retaining structures **Hrs-06**

Unit-III Sheet Pile Retaining Structures
Sheet piles walls bulk heads: Types of sheet piles, constructional features cantilever & anchored walls, their suitability; Analysis for design of cantilever walls in cohesion less and cohesive soils, approximate analysis; Analysis for anchord sheet pile with free end & fixed end support condition; Blum's citeria; Deadman and anchors - location and design principles **Hrs-06** **Hrs-08** **Hrs-08**

Unit-IV Compacted Embankments
Compaction control in field compaction; consideration of placement moisture content during field compaction, over compaction; Effects of compactive effect on

compaction of clayey and sandy soil; Effects of lifts in deep compaction, correction for excluded grain sizes in laboratory compaction; Tests Theories of Compaction: water film and lubrication concept, microstructure concept **Hrs-06**

Unit-V Stability of Slopes

Friction circle methods, factors of safety, stability numbers and use of stability charts, base failure; Stability of earthdam slopes for steady seepage and sudden draw down; Approximate analysis for plain slip surface, Bishop's method of slope stability

Cofferdams

Types, suitability; stability analysis of cellular and diaphragm type cofferdams; TVA method; interlocked stresses **Hrs-06**

Text Books:
1. Arora K.R., Soil Mechanics and Foundation Engineering, 5th Edition, Standard Publishers Distributors, 2005
2. Punmia,B.C., Soil mechanics & Foundation, 16th Edition, Laxmi Publishers, 2005

Reference Books:
1. Gopal Ranjan, Basic and Applied Mechanics, 2nd Edition, New Age International, 2005
2. Das,B.M., Principal of Geotechnical Engineering, 7th Edition, Cengage International, 2010

BCEL 424 ENERGY CONSERVATION AND ENVIRONMENT (Theory) (Elective-) (Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objective
1. Know fundamentals of nonconventional energy and Energy Scenario.
2. Learn different non-conventional energies and Energy Conversion Methods.
3. Explain Financial and economic aspect of nonconventional energy.

Course Outcome: Student shall be able to
CO1 Explain fundamentals of nonconventional energy and Energy Scenario.
CO2 Explain fundamentals and concepts of solar energy.
CO3 Describe biomass energy and biomass conservation technologies.
CO4 Use of non-conventional energy in accordance with area.

Unit-I Overview of Global and Indian Energy Scenario; Fundamental of energy- science and technology Resource, Principle of energy Conservation ; Various aspect of energy conservation;Flow of Energy Through Ecosystem, Renewable and Non- Renewable Energy Sources; Necessity of energy storage

Unit-II Solar energy basics : Solar constant, Solar Radiation at earth's Surface, Solar time; Solar radiation Geometry, Empirical equations for estimating solar radiation availabilities on horizontal surface for cloudy skies ; Measurement of solar Radiation, estimation of solar radiation. Physical Principles of the conversion of solar radiation into heat ; Solar Energy collectors : non-concentrating and concentrating, transitivity of cover systems, energy balance equation,

collector efficiency ;Application of the solar energy, solar photovoltaic system **Hrs-08**

Unit-III Biomass: Energy from biomass, biomass resources ; Basic concern and issues , types of biogas plant; Operational Parameter of a biogas plant; Availabilities of raw materials and estimation of gas yield;, biogas production from waste biomass; Energy plantation ; Energy farming ;biomass conversion technologies: Combustion, Gasification, anaerobic digestion, fermentation, pyrolysis; Biomass Energy Programme in India. **Hrs-08**

Unit-IV Brief introduction to non- conventional energy: oceans and tidal, geothermal, hydro; Wind energy ; site selection consideration; basic principles of wind energy conversion; application of wind energy.

Text Books:
1. Lal Jayamaha Energy-Efficient Building Systems, McGraw Hill Publication.

Reference Books:
1. AA M Sayigh Solar Energy Applications in Buildings Academic Press
2. H P Garg, J Prakash, Solar Energy Fundamentals & Applications Tata McGraw Hill Publishing.

IS Codes Energy Conservation Building Code, 2007
e- Learning Resources:
www.nptel.iitrr.ac.in/iitroorki.
www.nptel.iitg.ac.in/iitGuahati.

BCEL 425: Introduction to Structural Dynamics (Theory) (Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:
1.
2.
3.

Course Outcome: Student shall be able to
CO1 Calculate the response for free and forced vibrations of SDOF system
CO2 Evaluate response of SDOF systems under different types of loading
CO3 Apply the various numerical schemes and methods to find the mode shapes of MDOF structures

Syllabus

Unit-I Sources of vibration, types of excitations, Spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle, Single degree of freedom systems; Mathematical model of physical systems; Free vibrations of undamped and viscously damped systems **Hrs-10**

Unit-II Coulomb damping, viscous damping. Response of viscously damped SDOF systems to harmonic excitation Equivalent viscous damping; **Hrs-07** structural damping, Response of an undamped SDOF to short duration impulse; unit impulse response

Unit-III Response of undamped system of rectangular, triangular and ramp loading; response to general dynamic excitation; Duhamel integral method **Hrs-05**

Unit-IV Multi-Degree Freedom System, stiffness and flexibility approaches, Lumped-mass matrix, free vibrations fundamental Frequencies and mode

shapes, orthogonality of modes, numerical schemes to find mode shapes and frequencies **Hrs-10**

Text Books:
1. Dynamics of Structures, R.W. Clough and J. Penzian, 2nd edition, McGraw-Hill Inc, 1993
2. Chopra, A. K. (1995). Dynamics of structures (Vol. 3). New Jersey: Prentice Hall.

Reference Books:
1. Paz, M. (2012). Structural dynamics: theory and computation. Springer Science & Business Media.
2. Timoshenko, S. P., & Young, D. H. (1948). Advanced dynamics. McGraw Hill
3. Structural Dynamics Vibrations & Systems, Madhujit Mukhopadyay, Ane Books India, 2006

Online Certification Courses:
1. Structural Dynamics, Ramancharla Pradeep Kumar, Earthquake Engineering Research Centre, IIIT Hyderabad
(NPTEL)

Best faculty members from IIT:
1. Ramancharla Pradeep Kumar, IIIT Hyderabad
2. Dr. R. S. Jangid, IIT Bomaby
3. Dr. O. R. Jaiswal, VNIT, Nagpur

**BCEL 426 GEOLOGY AND EARTH SCIENCE
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50**

Course Objectives:
1. To study the origin, development and ultimate fate of various surface features of the earth
2. To understand the nature of geographic distribution of rocks and engineering properties of rock on the earth
3. To study methods of determining intensity and magnitude of earthquakes

Course Outcome: Student shall be able to
CO1 Use knowledge of rock & soil mechanics required for design of civil engineering structures
CO2 To study geological factors affecting the location, design, construction, operation and maintenance of engineering works
CO3 An ability to perform studies and opinions regarding geological hazards, erosion, flooding, dewatering and seismic investigations
CO4 To develop the ability to understand various aspects of earth science

Syllabus
Unit-I Introduction: Various branches of geology - Relevance of Geology in Engineering. Geologic time scale.
Physical Geology: Geomorphic processes-Rock weathering-Formation of soils soil profiles-soils of India – Geologic work and engineering significance of rivers and ocean.
Applications of geology: Engineering properties of rocks. Engineering considerations of structures of rocks. Rock as a construction material, Building stone, Road metal and ballast. Application of geology for location, design and construction of dams, hydraulic structures, bridges and tunnels. **Hrs-08**
Unit-II Structural Geology: Deformation of rocks, folds, parts of fold, its classification and nomenclature, Identification joints, its definition, nomenclature and classification, Definition, nomenclature and

classification of fault, Recognition of fault and fold in the field and its effect on outcrops, Outliner and inliers, Problems on dip, strikes, thickness and depth of rock strata.
Mineralogy: Definition and classification of minerals, Isomorphism, polymorphism and pseudo orphism, General chemical and physical characters of the following mineral groups, Silica, Feldspar, olivine, Pyroxene, Amphibole, Mica, Feldpathoid and clay. **Hrs-08**
Unit-III Petrology: Rock cycle, Magma and its composition, Igneous rocks: Formation of igneous rocks, Forms, textures and structures, Tabular classification of igneous rocks.
Sedimentary rocks: Weathering, Erosion, Transportation andDeposition of sediments, Sedimentary Environments, Classification of sedimentary rocks.
Metamorphic rocks:
Definitions and agents of metamorphism, Types of metamorphism, Zones and grades of metamorphism, Ana taxis, Soils: soil profile and soil types. **Hrs-07**
Unit-IV Plate tectonics: Lithospheric plates-diverging, converging and transform boundaries-their characteristic features-midoceanic ridge, benioff zone and transform faults-significance of plate tectonic concept.
Earthquake: Elastic rebound theory-types of seismic waves-cause of earthquake intensity and magnitude of earthquake Locating epicentre and hypocenter-effect of earthquake-distribution of earthquake-earthquake resistant structures **Hrs-07**

Text Books:
1. Singh Parbin, "Engineering and General Geology", 2009,S. K. Kataria& Sons
2. Kesavulu, "Textbook of Engineering Geology",2009,Macmillan India Ltd

Reference Books:
1. SenguptaSupriya, "Introduction to Sedimentology" 1994, A. A. Balkema
2. Park R. G., "Foundation of Structural Geology," 2004 Routledge Publishing House
3. Arthur Holmes, Physical geology, 2nd Edition, Thomas Nelson, 1978

e- Learning Resources:
1. https://swayam.gov.in/course/4397-earth-
    sciences-for-civil-engineering-part-i-ii

Best faculty members from IIT:
1. Javed Malik - Indian Institute of Technology - Kanpur

**BCEL 427 : Prefabricated structures (Theory)
(Lectures–Tutorial–Practical) / Week (1-1-0-0)
Total Hrs: 30 Marks-50**

Course Objectives:
1. To impart knowledge to students on modular construction, industrialised construction.
2. To design of prefabricated elements and construction methods.

Course Outcome: Student shall be able to
C01 Demonstrate the general design principles of prefabrication.
C02 Design the individual prefabricated units.

C03 Understand the concepts of types of beams.

C04 Examine the current technologies and systems of prefabrication.

Syllabus

Unit-I Introduction

Need for prefabrication – Principles – Materials – Modular coordination – Standarization –Systems – Production – Transportation – Erection. **Hrs-07**

Unit-II Prefabricated components

Behaviour of structural components– Construction of roof and floor slabs – Wall panels – Columns – Shear walls **Hrs-08**

Unit-III Design Principles

IS code specifications, Design considerations: Economy of prefabrication-assessment of handling and erection spaces

Joints and connections

Basic mechanism-compression joint-shear joint-tension jointPin jointed connection-beam to column-column foundation connection **Hrs-08**

Unit-IV Machinery and equipment

Plant machinery, casting yard

Current technology

Text Books:

1. Kim S.Elliot (2002), Precast concrete structures, B.H. Publishers, United Kingdom

Reference Books:

1. Promyslov,V. (1998), Design and Erection of reinforced concrete structures, MIR Publishers, Moscow.

2. Levit, M.,(2000), Precast concrete materials, Manufacture properties and usage, Applied science Publishers, Moscow CBRI, Building materials and components, India, 1990

BCEL 428: PRESTRESSED CONCRETE STRUCTURES (Theory)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50

Course Objectives:

1. To analysis the basic concepts of prestressing so that student understands the same

2. To evaluate the prestressed components based on Indian code provisions

3. To design the rectangular section

Course Outcome: Student shall be able to

CO1 introduce prestressing methods, principles and concepts

CO2 determine losses in prestress & anchorage zone stresses

CO3 compute shear strength and ultimate shear resistance capacity as per IS code

CO4 design of prestressed concrete beams, stresses at transfer, service load, limitstate of collapse in flexure and shear

Syllabus

Unit-I INTRODUCTION AND ANALYSIS FOR STRESS

Basic concepts - terminology - system of prestressing, pretensioning, post tensioning, principle of prestressing, types of prestressing. Assumptions, analysis of prestress, concentric & eccentric tendon, resultant stresses, rectangle, I-section (symmetrical only), concepts of prestressing, stress concept, strength concept and load balancing concept. **Hrs-08**

Unit-II LOSSES OF PRESTRESS AND ANCHORAGE ZONE STRESSES

Losses of prestress, types, losses due to elastic deformation of concrete, shrinkage of concrete, creep of concrete, friction, anchorage slip. Anchorage zone stresses, stress distribution in end block, investigations on anchorage zone stresses, Indian code provision only. **Hrs-08**

Unit-III SHEAR STRENGTH

Behavior of prestressed concrete members under shear, Shear strength, principal stresses, Ultimate shear resistance, Indian Standard code provision. **Hrs-07**

Unit-IV DESIGN OF PRESTRESSED CONCRETE BEAM

Design of sections for flexure, stress condition, minimum section modulus, stresses at transfer, service loads, prestressing force, eccentricity, check for stresses, initial and final conditions, limit state of collapse in flexure, shear. (Rectangular Section only) **Hrs-07**

Text Books:

1. Krishnaraju R, "Prestressed Concrete", Tata McGraw-Hill Education, New Delhi, 2006.

2. Pandit .G.S, Gupta .S.P, "Prestressed Concrete", CBS Publishers & Distributors, 2008.

Reference Books:

1. Lin T.Y, Design of, "Prestressed Concrete Structures", Asia Publishing House, Bombay 1995

2. Guyon .V, "Limit State Design of Prestressed Concrete", Vol.I & II Applied Science Publishers, London, 1992.

3. IS: 1343- 1980, "IS Code Of Practice For Prestressed Concrete", BIS, New Delhi, 1980.

Online Certification Courses:

1. Prestressed Concrete Structures, Dr. Amlan K Sengupta and Prof. Devdas Menon , Indian Institute of Technology Madras

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BCEL 429 Bridge Engineering (Theory)
(Lectures–Tutorial–Practical) / Week (1-1-0-0)
Total Hrs: 30 Marks-50

Course Objectives:

1. To provide an exposure to essential of bridge engineering with focus on structural design

2. To design RCC bridge with substructure for IRC loadings.

3. To study specification of IRC standard live load

Course Outcome: Student shall be able to

C01 Develop appropriate bridge solutions given site, geometric, functional and aesthetic constraints and drawing on other professional disciplines as required.

C02 Complete detailed design of bridge structures in steel and concrete.

C03 Assess the whole life costs of bridge structures.

C04 Evaluate the substructures like pier, abutments, bridge slabs, etc

Syllabus

Unit-I Components of Bridges, Classification, Importance of Bridges, Investigation for Bridges, Selection of Bridge site, Economical span, Location of

piers and abutments, Subsoil Exploration, Scour depth, Traffic projection, Choice of bridge type**Hrs-08**
Unit-II Specification of road bridges, width of carriageway, loads to be considered, dead load, IRC standard live load, Impact effect **Hrs-08**
Unit-III General design considerations, Design of slab culvert, Foot bridge. Introduction to Pre-stressed concrete bridge, Box Culvert and Fly over bridges **Hrs-07**
Unit-IV Evaluation of sub structures, Pier and abutments caps, Analysis of pier, Abutments. Type of foundations, Design of well foundation. **Hrs-07**
Text Books:
1. Ponnuswamy, S, Bridge Engineering, 2nd Edition, Tata McGraw - Hill, New Delhi, 2007.
2. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006.
Reference Books:
1. Pietro Croce et al., Design of Bridges, Published by Czech Technical University in Prague, 2015
2. N. Krishna raju, Design of Bridges, Oxford and IBH Publishing, 2010.
3. Homayoun Abrishami, Design of Reinforced Concrete Bridges, University of Toronto,
Online Certification Courses:
1. Reinforced Concrete Road Bridges, Prof. Nirjhar Dhang, IIT Kharagpur (Nptel).
Best faculty members from IIT:
1. Prof. Nirjhar Dhang, IIT Kharagpur
2. Prof. A. K. Jain, IIT Delhi

BCEL 430: Forensic Civil Engineering (Theory) (Elective)
(Lectures) / Week (2-0-0-2)
Total Hrs: 30 Marks-50
Course Objectives:
1. To provide basic steps in a forensic investigation
2. To introduce the Professional practice and ethics, Legal issues.
3. To Use Essential forensic engineering methods and techniques
4. To in the fields of Building Engineering, Aeronautical Engineering and Biomechanical Engineering
Course Outcome: Student shall be able to
C01 Identify basic steps in a forensic investigation
C02 Use Professional practice and ethics, Legal issues
C03 Use Essential forensic engineering methods and techniques
C04 Apply in the fields of Building Engineering, Aeronautical Engineering and Biomechanical Engineering
Syllabus
Unit-I **Introduction:** Introduction to forensic engineering, Forensic investigations tools and techniques, Failures - types, causes and mechanisms, Monitoring and instrumentation, Mitigation of failure.
Unit-II Professional practice and ethics, Legal issues, Repairs and remediation, Risk and risk assessment, Assessment of damage, Case studies.
Unit-III *Case from Civil Engineering* various structural failure mechanisms and practice setting hypotheses for structural failures. **Hrs-06**

Unit-IV *Case from Aerospace Engineering & Biomechanical Engineering*
Failure mechanism fatigue in airplanes and test for occurred. Contamination of medical instruments and technical procedural aspect. **Hrs-08**
Text Books:
1. Forensic Engineering: Civil Engineering Special Issue1 Paperback – Import, 1 Jan 2009 by Simon Fullalove
2. Forensic Structural Engineering Handbook Hardcover – Import, 1 Jan 2010 by Robert Ratay
Reference Books:
1. Proceedings, Conference on Forensic Civil Engineering, Association of Consulting Civil Engineers (I), August,2013
Online Certification Courses:
1. SWAYAMCOURSE==
https://swayam.gov.in/forensic-science/c/5/science
Best faculty members from IIT:
1. **Dr. Anjan Kumar S Email:** sak@iitg.ac.in**Phone**: 0361-258 3332, +91 8134960628 (M)

BCEL 431 THEORY OF ELASTICITY AND ELASTIC STABILITY (THEORY) (ELECTIVE-)
(Lectures–Tutorial–Practical) / Week (2-0-0-2)
Total Hrs: 30 Marks-50
Course Objective:
1. To introduce the errands of theory of elasticity and methods of solving the structural problems.
2. To introduce the basic concepts and the state of the art of static and dynamic stability of structures
Course Outcome: Student shall be able to
CO1 Analyze 2D/3D Stress and strain problems with different boundary condition.
CO2 Solve the torsional problems on different elements.
CO3 Analyze differential equations for beam- column.
CO4 Solve various forces on built-up beams.
Unit-I Analysis of stress and strain in 2 dimensions: Introduction, Types of forces, Components of stresses and strains, Stress-strain relation, Plane stress and plane strain, Strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations(rectangular coordinates), Airy's stress function **Hrs-08**
Unit-II Analysis of stress and strain in 3 dimensions: Components of stress, Principal stresses, Stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations **Hrs-07**
Unit-III Bending of cantilever of narrow rectangular section loaded at end, bending of simply Supported beam with uniform load, torsion of non-circular sections, Differential equation for beams columns with concentrated loads, continuous lateral loads and couples for simply supported ends **Hrs-08**
Unit-IV Energy method for elastic bucking of columns, approximate method, buckling of columns on elastic foundation ,Effect of shearing force on critical load , buckling of built up columns **Hrs-07**
Text Books: **Hrs-08**
1. Theory of Elastic Stability Timoshenko, S.P Tata Mc-Graw Hill Publsihing Co. New Delhi, 1961, 2ND Edition

Reference Books:

1. Flexural Torsional Buckling of Structures Trahair, N.SE & FM SPON, London, 1969
2. Theory of Beam-Columns-Space Behaviour and Design Chen, W.F Tata McGraw Hill International 1996, 2ND Edition
3. Principles of Structural Stability Theory Alexander Chajes Prentice Hall College Division 1974, 7TH Edition

IS Codes

e-LearningResources:

https://nptel.ac.in/courses/105108070/

Online Certification Courses:

Best faculty members from IIT:

1. Prof. Amit Shaw, Associate Professor, Department of Civil Engineering, IIT Kharagpur.
2. Prof. Biswanath Banerjee, Assistant Professor. Department of Civil Engineering, IIT Kharagpur.