

Civil Engineering

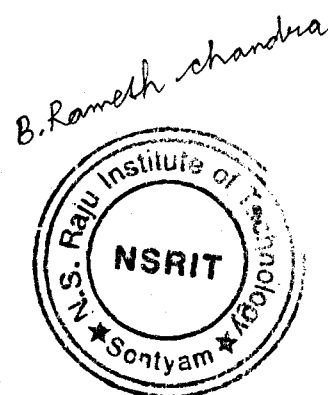
Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards

	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

Semester I					Contact Hours				
No.	Code	Course	POs	L	T*	P	C		
01	20HSX01	Communicative English	10	3	0	0	3.0	HS	
02	20BSX11	Linear Algebra and Differential Equations	1, 12 ¹	3	1	0	3.0	BS	
03	20BSX21	Engineering Chemistry	1	3	0	0	3.0	BS	
04	20ESX01	Engineering Drawing	1, 5, 10	1	0	4	3.0	ES	
05	20ESX02	Programming for Problem Solving Using 'C'	1	3	0	0	3.0	ES	
06	20HSX02	Communicative English Lab	10	0	0	3	1.5	HS	
07	20BSX22	Engineering Chemistry Lab	1, 4	0	0	3	1.5	BS	
08	20ESX07	Programming for Problem Solving Using 'C' Lab	1, 4	0	0	3	1.5	ES	
Sub-total				13	01	13	19.5		
Semester II									
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS	
02	20BSX31	Engineering Physics	1	3	0	0	3.0	BS	
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES	
04	20ESX04	Engineering Mechanics	1	3	1	0	3.0	ES	
05	20CE201	Building Materials and Construction Components	2, 5	3	0	0	3.0	ES	
06	20BSX32	Engineering Physics Lab	1, 4	0	0	3	1.5	BS	
07	20ESX08	Basic Electrical and Electronics Engineering Lab	1, 4	0	0	3	1.5	ES	
08	20ESX06	Engineering Workshop	4	0	0	3	1.5	ES	
09	20MCX01	Environmental Science	1	2	0	0	-	MC	
Sub-total				17	03	09	19.5		
Semester III									
01	20BSX13	Numerical Methods and Transforms	1	3	1	0	3.0	BS	
02	20CE302	Building Planning and Drawing	1, 10, PSO 1	3	0	0	3.0	PC	
03	20CE303	Surveying	1	3	1	0	3.0	PC	
04	20CE304	Strength of Materials	1, PSO 1	3	1	0	3.0	PC	
05	20CE305	Fluid Mechanics	1, 3, PSO 2	3	1	0	3.0	PC	
06	20CE306	Surveying Lab	5, 10	0	0	3	1.5	PC	
07	20CE307	Strength of Materials Lab	1, 4	0	0	3	1.5	PC	
08	20CE308	Fluid Mechanics and Hydraulic Machinery Lab	1, 4	0	0	3	1.5	PC	
09	20CES01	Computer Aided Building Drawing	5, 10, PSO 1	1	0	2	2.0	SC	
10	20MCX02	Constitution of India	-	2	0	0	-	MC	
Sub-total				18	04	11	21.5		

*Suggested hours for tutorial

¹By default all courses are mapped to PO 12 as they are weakly contributing

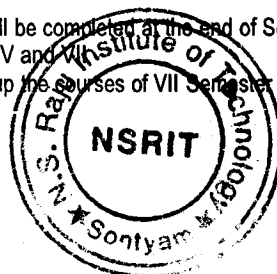


Semester IV							
No.	Code	Course	POs	Contact Hours			
				L	T	P	C
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0
02	20CE402	Hydraulics and Hydraulic Machinery	1, 3, PSO 2	3	1	0	3.0
03	20CE403	Concrete Technology	1, 2, 6, 8	3	0	0	3.0
04	20CE404	Soil Mechanics	1, 2, 3, 6, PSO 1	3	0	0	3.0
05	20CE405	Construction Project Management	11	3	0	0	3.0
06	20CS407	Python Programming Lab	1	0	0	3	1.5
07	20CE407	Concrete Technology Lab	1, 2, 4	0	0	3	1.5
08	20CE408	Soil Mechanics Lab	1	0	0	3	1.5
09	20CES02	Building Information Modeling Lab	1, 5, 10	1	0	2	2.0
Sub-total				16	01	11	21.5
Semester V							
01	20CE501	Structural Analysis	1, 3, PSO 1	3	1	0	3.0
02	20CE502	Design of Reinforced Concrete Elements	1, 2, 3, 8, PSO 1, PSO 2	3	1	0	3.0
03	20CE503	Foundation Engineering	1, 2, 3, 6, 8, 12, PSO 1	3	1	0	3.0
04	-	Professional Elective I	-	3	0	0	3.0
05	-	Open Elective I	-	3	0	0	3.0
06	20CE506	Drawing of Reinforced Concrete Structures	1, 3, 10, PSO 1	0	0	3	1.5
07	20CE507	Irrigation Design and Drawing	5, 10, 6, PSO 1, 2	0	0	3	1.5
08	-	MOOCs	12	0	0	0	2.0
09	20MCX03	Intellectual Property Rights and Patents	-	2	0	0	-
10	-	Summer Internship #1 ²	5, 8, 9, 10, PSO 1	0	0	0	1.5
11	-	Technical Paper Writing	-	0	0	2	-
Sub-total				17	03	08	21.5
Semester VI							
01	20CE601	Transportation Engineering	1, 2, 3, PSO 1	3	0	0	3.0
02	20CE602	Design of Steel Structures	1, 3, 12, PSO 1	3	1	0	3.0
03	20CE603	Environmental Engineering	3, 6, 7, 12	3	0	0	3.0
04	-	Professional Elective II	-	3	0	0	3.0
05	-	Open Elective II	-	3	0	0	3.0
06	20CE606	Detailing and Drawing of Steel Structures	1, 3, 10, PSO 1	0	0	3	1.5
07	20CE607	Transportation Engineering Lab	1, 2, 4, PSO 2	0	0	3	1.5
08	20CE608	Environmental Engineering Lab	1, 6, 8, PSO 1	0	0	3	1.5
09	20CES04	Estimation and Costing	1, 11, 12	0	0	4	2.0
10	20MCX04	Indian Traditional Knowledge	-	2	0	0	-
Sub-total				17	01	13	21.5
Semester VII							
01	-	Professional Elective III	-	3	0	0	3.0
02	-	Professional Elective IV	-	3	0	0	3.0
03	-	Professional Elective V	12	3	0	0	3.0
04	-	Open Elective III	-	3	0	0	3.0
05	-	Open Elective IV	12	3	0	0	3.0
06	20HSX04	Professional Ethics	8	3	0	0	3.0
07	20CES05	Finishing School for Civil Engineering	9, PSO 1	0	0	4	2.0
08	-	Summer Internship #2 ²	5, 8, 9, 10, PSO 1	0	0	0	3.0
Sub-total				18	0	04	23.0
Semester VIII							
01	-	Full Semester Internship ³	5-10, PSO 1, PSO 2	0	0	0	06
02	-	Capstone Project ³	5-10, PSO 1, PSO 2	0	0	0	06
Sub-total				0	0	0	12.0
Total Credits				-	-	-	160

² The work pertaining to Summer Internship #1 and #2 shall be completed at the end of Semesters IV and VI respectively.

The assessment shall be carried out during Semesters V and VII respectively.

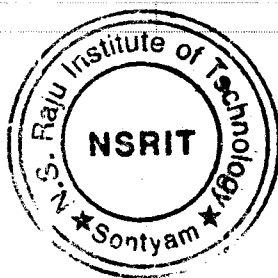
³ The students opting for FSI in VII Semester should take up the courses of VII Semester in VIII Semester



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List of Electives

Professional Elective #1						
1	20CE001	Advanced Concrete Technology	-	3	0	0 3.0 PE
2	20CE002	Environmental Geotechnics	-	3	0	0 3.0 PE
3	20CE003	Transportation Planning and Management	-	3	0	0 3.0 PE
4	20CE004	Water Resources Systems Planning and Management	-	3	0	0 3.0 PE
5	20CE005	Construction Equipment Automation	-	3	0	0 3.0 PE
6	20CE006	Harbor Engineering	-	3	0	0 3.0 PE
Professional Elective #2						
7	20CE007	Pre-Stressed Concrete	-	3	0	0 3.0 PE
8	20CE008	Environmental Impact Assessment	-	3	0	0 3.0 PE
9	20CE009	Pavement Analysis and Design	-	3	0	0 3.0 PE
10	20CE010	Urban Hydrology	-	3	0	0 3.0 PE
11	20CE011	Sustainable Construction Methods	-	3	0	0 3.0 PE
12	20CE012	Advanced Structural Analysis	-	3	0	0 3.0 PE
Professional Elective #3						
13	20CE013	Repair and Rehabilitation of Structures	-	3	0	0 3.0 PE
14	20CE014	Solid Waste Management	-	3	0	0 3.0 PE
15	20CE015	Traffic Engineering	-	3	0	0 3.0 PE
16	20CE016	Hydraulic Structures	-	3	0	0 3.0 PE
17	20CE017	Construction Cost Analysis	-	3	0	0 3.0 PE
18	20CE018	Coastal Zone Management	-	3	0	0 3.0 PE
Professional Elective #4						
19	20CE019	Self-Healing Concrete	-	3	0	0 3.0 PE
20	20CE020	Solid Waste Management	-	3	0	0 3.0 PE
21	20CE021	Urban Transportation Planning	-	3	0	0 3.0 PE
22	20CE022	Hydro Power Engineering	-	3	0	0 3.0 PE
23	20CE023	Safety Engineering	-	3	0	0 3.0 PE
24	20CE024	Ocean Engineering	-	3	0	0 3.0 PE
Professional Elective #5						
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.						PE
Open Elective #1						
25	20CE001	Urban Environmental Health	-	3	0	0 3.0 OE
26	20CS001	Data Structures and Algorithms	-	3	0	0 3.0 OE
27	20AIO01	Machine Learning for Engineers	-	3	0	0 3.0 OE
28	20DSO01	Introduction to Database Management Systems	-	3	0	0 3.0 OE
29	20ECO01	Architectures and Algorithms of IoT	-	3	0	0 3.0 OE
30	20EE001	Introduction to Renewable Energy Sources	-	3	0	0 3.0 OE
31	20MEO01	Nano Technology	-	3	0	0 3.0 OE
32	20SHO01	Women and Society	-	3	0	0 3.0 OE
Open Elective #2						
33	20CE002	Ecology, Environment and Resources Management	-	3	0	0 3.0 OE
34	20CS004	Internet of Things	-	3	0	0 3.0 OE
35	20AIO02	Fundamentals of Deep Learning	-	3	0	0 3.0 OE
36	20DSO02	Introduction to Data Science	-	3	0	0 3.0 OE
37	20ECO02	IoT for Smart Grids	-	3	0	0 3.0 OE
38	20EE002	Electrical Safety and Management	-	3	0	0 3.0 OE
39	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0 3.0 OE
Open Elective #3						
40	20CE003	Disaster, Risk Mitigation and Management	-	3	0	0 3.0 OE
41	20CS302	Operating Systems	-	3	0	0 3.0 OE
42	20AIO03	Intelligent Robots and Drone Technology	-	3	0	0 3.0 OE
43	20DSO03	Introduction to Big Data	-	3	0	0 3.0 OE
44	20ECO03	Privacy and Security in IoT	-	3	0	0 3.0 OE
45	20EE003	Low-cost Automation	-	3	0	0 3.0 OE
46	20SHO03	Design Thinking	-	3	0	0 3.0 OE



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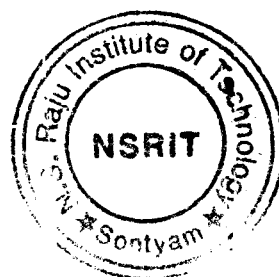
47	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
Open Elective #4								
The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.								
B. Tech. (Honors)								
Category I								
1	20CEH01	Cognitive Management of IoT for Smart Cities	-	4	0	0	4.0	HO
2	20CEH02	Energy Efficient Buildings	-	4	0	0	4.0	HO
3	20CEH03	Structural Health Monitoring	-	4	0	0	4.0	HO
Category II								
4	20CEH04	Structural Failure Protection using AI	-	4	0	0	4.0	HO
5	20CEH05	Architecture and Town Planning	-	4	0	0	4.0	HO
6	20CEH06	Safety Analysis and Risk Management	-	4	0	0	4.0	HO
Category III								
7	20CEH07	Intelligent Transportation Networks	-	4	0	0	4.0	HO
8	20CEH08	Building Information Modelling	-	4	0	0	4.0	HO
9	20CEH09	Traffic Engineering and Management	-	4	0	0	4.0	HO
Category IV								
10	20CEH10	Structural Health Monitoring using IoT	-	4	0	0	4.0	HO
11	20CEH11	GIS and Remote Sensing	-	4	0	0	4.0	HO
12	20CEH12	Disaster Risk Mitigation	-	4	0	0	4.0	HO
B. Tech. (Minor with Specialization)								
Category I								
1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E-Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Fundamentals of Electronics	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI
Category II								
8	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
9	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
10	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
11	20EEM02	Design of Photovoltaic systems	-	3	0	0	3.0	MI
12	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
13	20AIM02	Machine Learning with Python	-	3	0	0	3.0	MI
14	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI
Category III								
15	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
16	20CSM03	Database Security	-	3	0	0	3.0	MI
17	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
18	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
19	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
20	20AIM03	Interpretable Deep Learning	-	3	0	0	3.0	MI
21	20DSM03	Data Governance	-	3	0	0	3.0	MI

List of Honors offered by Civil Engineering Program

1. Applications of IoT in Civil Engineering
2. Smart Cities
3. Structural safety and Risk Management

List of Minor with Specialization offered by Civil Engineering Program

1. Environmental Engineering, Climate Changes and Sustainability



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PC 20CE501 Structural Analysis

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO3	PSO1	
20CE501.1	Able to calculate the deflections for the determinate and indeterminate structures by using various methods.	3	3	3	L1, L2, L3
20CE501.2	Apply slope deflection method to analyze continuous beams and portal frames	3	3	3	L1, L2, L3
20CE501.3	Apply moment distribution method for beams and portal frames	3	3	3	L1, L2, L3
20CE501.4	Analyze two hinged and three hinged arches	3	3	3	L1, L2, L3
20CE501.5	Analyze beams subjected to moving loads using Influence line diagrams	3	3	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Deflection of Determinate Structures

12 Hours

Determination of Static and Kinematic Indeterminacy in Beams, plane and space Trusses and Frames - Degree of Freedom - Analysis of plane trusses by method of joint, method of section and tension coefficient method - Castiglione's First and Second Theorems - Deflection of statically determinate beams, pin jointed trusses and rigid jointed frames by energy method and unit load method. - Analysis of pin connected indeterminate trusses by consistent deformation method - Betti's reciprocal theorem.

Determination of Static and Kinematic Indeterminacy in Beams

Unit II: Slope Deflection Method

12 Hours

Derivation of slope deflection equations - Application to Continuous beams and rigid frames (with and without sway) - Effect of Support displacements.

Application to Continuous beams

Unit III: Moment Distribution Method

12 Hours

Absolute and relative stiffness and carry over factors - Analysis of continuous beams - Plane rigid jointed frames with and without sway - Effect of settlement of supports - Nayler's simplification.

Absolute and relative stiffness and carry over factors

Unit IV: Arches

12 Hours

Arches as structural forms - Examples of arch structures - Types of arches - Analysis of three hinged, two hinged and fixed arches having parabolic and circular shapes - Settlement and temperature effects.

Temperature effects on arches

Unit V: Moving Loads and Influence Lines

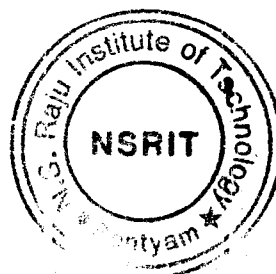
12 Hours

Influence Lines: Introduction - Construction of ILD for shear force and bending moment at a sections-determination of load positions for maximum shear force and bending moments for simply supported and overhanging beams with several point loads and UDL and determination of their values - Sketching of absolute maximum BMD.

Influence line diagrams for SF and BM

Text Books

1. Hibbeler, R. C., "Structural Analysis", 6th Edition, Pearson Publications, New Delhi 2012.
2. Vazirani & Ratwani, "Analysis of Structures", 19th Edition, Khanna Publications, 2008
3. Vaidyanathan, R. and Perumal, P., "Comprehensive Structural Analysis" (Vol. I & II), Laxmi Publications Pvt. Ltd., New Delhi.
4. Bhavikatti, S. S., "Analysis of Structures", (Vol. I & II), 6th Edition, Vikas Publications, 2009.



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Reference Books

1. Reddy, C. S., "Structural Analysis", Tata McGraw Hill, New Delhi, 2008.
2. Devdas Menon, "Structural Analysis", Narosa Publishing Housing Pvt. Ltd.
3. Pandit, G. S. and Gupta, S. P., "Structural Analysis: A Matrix Approach", Mc Graw Hill Pvt. Ltd.

Web References

1. Introduction to Structural Analysis – Engineering LibreTexts
2. NPTEL :: Civil Engineering – NOC:Structural analysis I
3. Structural Analysis1.pdf (giacr.ac.in)

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	20	20
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

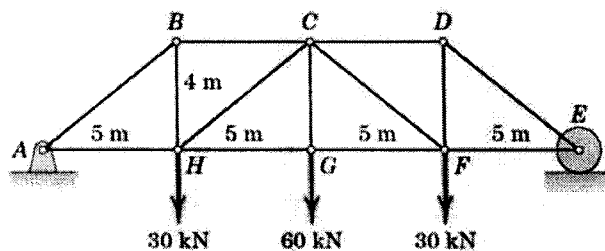
- L1: Remember**
1. What is carry over factor?
 2. What is distribution factor?
 3. What is relative stiffness?
 4. What is point of contra flexure?
 5. What are the fixed end moment for a fixed beam of length L and subjected to udl of w kN/m?

L2: Understand

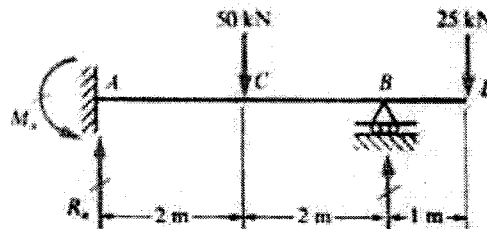
1. Explain the Clapeyron's theorem of three moments.
2. What do you understand by an Influence line diagram (ILD).
3. Difference between 'Beam-action' and 'Arch-action'.
4. What is the concept of the influence line?

L3: Apply

1. Determine the force in each member of the loaded truss by Method of Joints
Is the truss statically determinant externally? Is the truss statically determinant internally? Are there any Zero Force Members in the truss

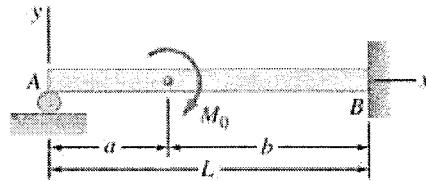


2. Solve Problem (a propped cantilever beam with an overhang). Calculate the reactions R_a , R_b and M_a for the propped cantilever beam with an overhang shown in the figure. (Take the reaction R_b at support B as the redundant)

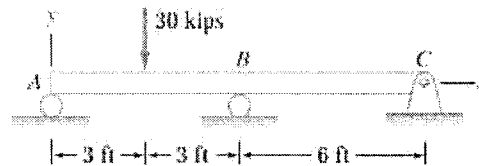


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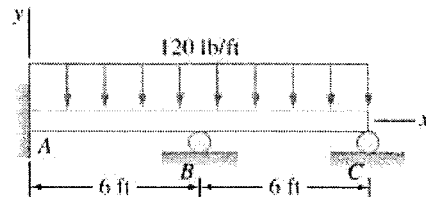
3. Solve the following problem by choosing M_A and M_B as the redundant reactions. Determine all the support reactions for the propped cantilever beam shown in the figure



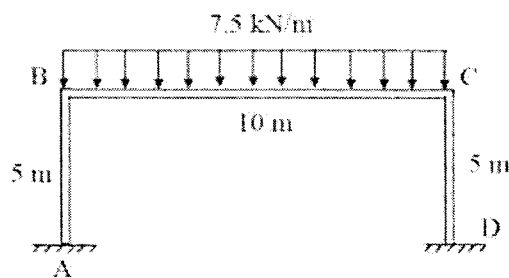
4. Find all the support reactions for the beam shown below:



5. The beam ABC has a built-in support at A and roller supports at B and C. Find all the support reactions



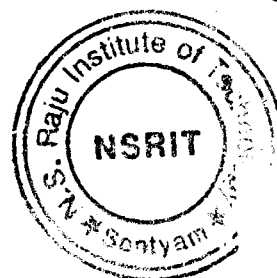
6. Analyze the Portal Frame (without sway) using Slope Deflection Method



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Chairman
Board of Studies(CE)



PC 20CE502 Design of Reinforced Concrete Elements

3 1 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs						DoK
		PO1	PO2	PO3	PO8	PSO1	PSO2	
20CE502.1	Understand the philosophy of different methods& design of reinforced concrete elements subjected to bending and shear	3	1	1	2	3	3	L1, L2, L3, L4
20CE502.2	Design slabs with different boundary conditions and RC Staircases as per IS: 456-2000.	3	1	1	2	3	3	L1, L2, L3, L4
20CE502.3	Design of underground and overhead water tank; design principle of retaining wall	3	1	1	2	3	3	L1, L2, L3, L4
20CE502.4	Design of short and long columns for axial, uniaxial and biaxial loading as per IS: 456-2000.	3	1	1	2	3	3	L1, L2, L3, L4
20CE502.5	Design of footings for axial load& principle of combined and raft foundation as per IS: 456-2000.	3	1	1	2	3	3	L1, L2, L3, L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Design Philosophy and Limit State design for Flexure

12 Hours

Introduction to RC design method, Difference between Working stress and Limit State Method – Philosophy and principle of limit state design with assumptions – Stress block parameters, concept of balanced section, under reinforced and over reinforced section – Limit State design of singly, doubly reinforced rectangular and flanged beam for bending – Design of beams for shear as per IS-456. Check for serviceability – Design for development length.

Modular ratio, Neutral axis depth

Unit II: Design of Slabs

12 Hours

Design of one way and two-way rectangular slabs subjected to uniformly distributed load for various boundary conditions and corner effects – Design of grid floor – Design of staircase – waist slab (dog legged).

Classification of slabs

Unit III: Limit State Design of Compression Members

12 Hours

Effective Length of a column, Design concepts of the column – Limit state design of short and long columns – Under axial loads, uniaxial and biaxial bending – Braced and un-braced columns- IS Code provisions

Types of R.C Column, slenderness ratio

Unit IV: Limit State Design of Footings

12 Hours

Different types of Footings – Design of Rectangular and square column footings with axial load and moment – reinforcement detailing. Design of combined footings – Raft foundation (Design principle only).

Design of wall footings, isolated footings

Unit V: Design of Water tank& Retaining Walls

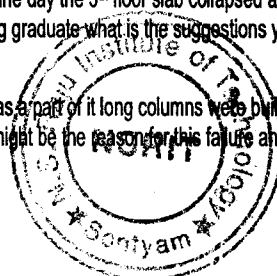
12 Hours

Principle of working stress method with assumptions – Design of underground rectangular tanks – Design of overhead circular water tank (slab, wall and ring beam). Cantilever and counterfort retaining walls (Design principle only).

Types of water tanks. Types of Retaining walls. Tank resting on grounds.

Case study (PO2)

- In a city of Andhra Pradesh where a building is in construction, on a fine day the 5th floor slab collapsed at the corners on the 4th slab. The experts found the reason for the failure is due to the column shear failure. As a civil engineering graduate what is the suggestions you recommend to over this failure and also suggest how to repair the structure and make it useful.
- In the place of Karnataka an industrial structure is being developed, as a part of it long columns were built to a height of 12m in a same lane by placing the beams in the middle. But on a certain day the columns were deformed. What might be the reason for this failure and what recommendation can be given from your side?



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Text Books

1. Punmia, B. C. and Jain A. K., "Limit State Design of Reinforced Concrete", Laxmi Publications Pvt. Ltd., New Delhi, 2016
2. Unnikrishna Pillai and Devdass Menon, Reinforced Concrete Design, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2016
3. Krishna Raju N., "Reinforced Concrete Design: IS:456-2000, Principles and Practice", New Age International Publishers, New Delhi, 2018

Reference Books

1. Subramanian, N., "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2014
2. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2013
3. Sinha, S. N., "Reinforced Concrete Design", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2014
4. Shah, V. L. and Karve, S. R., "Limit State Theory and Design of Reinforced Concrete", Structures Publications, Pune, 2013.
5. <https://www.uceb.eu/DATA/Books/THE%20CIVIL%20ENGINEERING%20HANDBOOK.pdf>

IS Codes

1. IS 456:2000 Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standards, New Delhi
2. IS 875:1987 Code of Practice for Design Loads (other than earthquake) for buildings and structures, Bureau of Indian Standards, New Delhi
3. National Building Code 2016, BIS, New Delhi
4. SP16:1980 Design Aids for Reinforced Concrete to IS456 : 1978, BIS, New Delhi
5. SP34:1987 Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi

Web References

1. <https://nptel.ac.in/courses/105/102/105102012/>
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

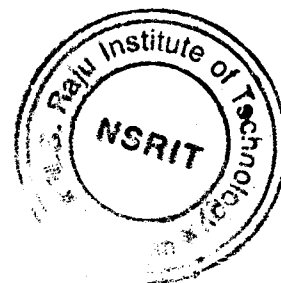
1. What is difference between limit state & working stress method?
2. What the difference is between under reinforced, over reinforced and balanced sections?
3. List out the types of beams
4. List out any 3 types of water tanks

L2: Understand

1. Classify the various types of slabs
2. Illustrate the difference between raft foundation and shallow foundation
3. Illustrate the concept of effective length of the column
4. Explain the principle for counter fort retaining walls

L3: Apply

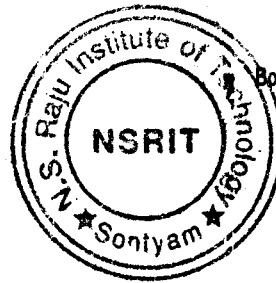
1. A Cantilever beam with span 3m has an effective depth of 350mm at the supports and 250mm at the end and a constant width of 250mm. It carries a load of 75kN/m including the self weight. It is reinforced with 04 bars of 20mm diameter. Use M20 grade of concrete and Fe 415 grade steel. Design shear reinforcement.
2. A simply supported RCC slab has to be provided for the roof of a room of clear dimensions 3m X 8m. Width of supporting wall is 300mm. The weight of weathering course over the slab is 1 kN/m². Take the live load on the slab as 2kN/m². Design the slab using M20 grade of concrete and HYSD steel. Check the design for the stiffness. Use M20 grade of concrete and Fe 415 grade steel.
3. Design a two way slab for the room 4000mm X 3500mm clear in size, if the super imposed load is 3kN/m² and floor finish is of 1kN/m². The edges of the slab are simply supported and corners are not held down.



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4. Calculate the ultimate strength in axial compression of a column 400mm in diameter and reinforced with 06 No, 25mm diameter and of grade Fe415, when the column helically reinforced by 8mm diameter bars at 30mm pitch. Assume clear cover 40mm and M20 grade of concrete.
5. Design a reinforced concrete footing of uniform thickness for a reinforced concrete column of 400mm X 400mm size carrying an axial load of 1200kN using M20 grade of concrete and Fe415 steel. The safe bearing capacity of soil is 220kN/m²
6. Design a counter fort retaining wall to retain 7m high embankment above ground level. The foundation is to be taken 1m deep where the safe bearing capacity of the soil may be taken as 180kN/m². The top of earth retained is horizontal, and soil weighs 18 kN/m³ while angle of internal friction $\phi = 30^\circ$. Coefficient of friction between concrete and soil may be taken as 0.5. Use M20 grade of concrete and Fe415 steel
7. Design a Circular water tank with flexible base resting on the ground to store 50,000 liters of water. The depth of tank may be kept 4m. Use M25 concrete and Fe 415 steel

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PC 20CE503 Foundation Engineering

3 1 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs							DoK
		PO1	PO2	PO3	PO6	PO8	PO12	PSO1	
20CE503.1	Determine soil properties by conducting various field and lab tests by getting exposure to IS: 1892-1979	3	2	3	3	2	1	3	L1, L2, L3, L4, L5
20CE503.2	Determine the bearing capacity of soils and settlements of footings in shallow foundations as per the recommendations of the IS: 1892-1979	3	2	3	3	2	1	3	L1, L2, L3, L4, L5
20CE503.3	Determine the slopes stability	3	1	3	3	2	1	3	L1, L2, L3, L4, L5
20CE503.4	Assess the load carrying capacity of piles using different methods and settlement analysis and know about well foundations	3	2	3	3	2	1	3	L1, L2, L3, L4, L5
20CE503.5	Estimate lateral earth pressures on retaining walls and check the stability	3	1	3	3	2	1	3	L1, L2, L3, L4, L5

1: Weakly Contributing | 2: Moderately Contributing | 3: Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Soil Exploration

12 Hours

Purpose of Subsurface Exploration - Depth of Exploration - Methods of Subsoil Exploration - Types of Soil Samples - Design Features affecting the Sample Disturbance - Planning of exploration program and Preparation of Soil investigation report

Types of borings

Unit II: Shallow Foundations

12 Hours

Introduction - Basic Definitions - Terzaghi's Bearing Capacity Theory - Effect of Water Table on Bearing Capacity - Factors affecting Bearing Capacity of Soil - IS Code method for Bearing Capacity of Footings - Bearing Capacity from In-situ tests (SPT and Plate Load Test). Settlement Analysis - Causes of settlement - Determination of settlement of Foundations on Granular and Clay soils - Allowable Settlements

Modes of shear failures

Unit III: Stability of Slopes

12 Hours

Analysis of Infinite and Finite Slopes - Stability Analysis of an Infinite Slopes in Cohesion less and Cohesive soils, Stability Analysis of Finite Slopes - Swedish Circle Method, Standard Method of Slices, Taylors Stability Number

Different factors of safety, Types of Slope Failures

Unit IV: Deep Foundations

12 Hours

Types of piles - Load carrying capacity of piles based on static pile formulae - Dynamic pile formulae - Pile load tests - Load carrying capacity of pile groups - Settlement of pile groups. Well Foundation - Components of well foundation - Different Shapes of wells - Construction and Sinking of Well - Tilts and Shifts.

Classification of piles

Unit V: Earth Pressure Theories

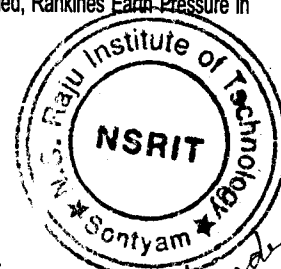
12 Hours

Different types of Lateral Earth Pressures, Rankines Earth Pressure Theory, Rankine's Earth Pressure when the Surface is Inclined, Rankines Earth Pressure in Cohesive Soils, Coulombs Wedge Theory, Culmanns Graphical Method

Rankines theory assumptions.

Text Books

1. Arora, K. R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2005
2. Purushothama Raj, P., "Soil Mechanics and Foundation Engineering", 2nd Edition, Pearson Education, 2013
3. Varghese, P. C., "Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2005
4. Gopal Ranjan and Rao A. S. R., "Basic and Applied soil mechanics", New Age International Pvt. Ltd, New Delhi, 2005
5. Murthy, V. N. S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors Ltd., New Delhi, 2007.



Reference Books

1. Narsinga Rao B. N. D., "Soil Mechanics and Foundation Engineering", Wiley India Pvt. Ltd., New Delhi, 2015
2. Swami Saran, Analysis and Design of Substructures, 5th Edition, Oxford and IBH Publishing Company Pvt. Ltd., 2006
3. Venkatramaiah, C. "Geotechnical Engineering", New Age International Publishers, New Delhi, 2007(Reprint)
4. Das, B. M., "Principles of Foundation Engineering", 7th Edition, Cengage Learning, 2011

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1. <https://nptel.ac.in/courses/105/105/105105176/>
2. <https://www.youtube.com/watch?v=IsYFtwHlw&list=PLbRMhDVUMngeiZjKPTPEF11CByXmYX3Kv>
3. <https://nptel.ac.in/courses/105/101/105101083/>
4. <https://www.youtube.com/watch?v=RJyXfz8jEns>
5. <https://www.uceb.eu/DATA/Books/THE%20CIVIL%20ENGINEERING%20HANDBOOK.pdf>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	15	10
L2	10	15
L3	35	35
L4	35	40
L5	5	0
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the objective of site investigation?
2. What is correction to be applied to find N value?
3. Define earth pressure at rest
4. What are modes of shear failure of shallow foundation?
5. Write the assumptions of Rankine's theory

L2: Understand

1. What is significant depth?
2. What are the limitations of Terzaghi's theory?
3. What is meant by critical depth of vertical cut for a clay soil?
4. Define Standard Penetration Number
5. Differentiate disturbed and undisturbed samples

L3: Apply

1. The internal diameter of a sampler is 40 mm and the external diameter is 42 mm. Will you consider the sample obtained from the sampler as disturbed or undisturbed?
2. The field N value in a deposit of fully submerged fine sand was 40 at a depth of 6m. The average saturated unit weight of the soil is 19 kN/m³. Calculate the corrected N value
3. Estimate the immediate settlement of a concrete footing, 1 m x 2 m, founded at a depth of 1m in a soil with $E = 10^4$ kN/m², $\mu = 0.3$. The footing is subjected to a pressure of 200kN/m². Assume the footing is rigid
4. A retaining wall has a vertical back and is 8m high. The back face of the wall is smooth and the upper surface of the fill is horizontal. Determine the thrust on the wall per unit length. Take $c = 10$ kN/m², $\gamma = 19$ kN/m³ and $\phi = 20^\circ$. Neglect tension
5. A 30cm diameter concrete pile is driven in a normally consolidated clay deposit 15 m thick. Estimate the safe load. Take $c_u = 70$ kN/m² and adhesion factor is 0.9 and FOS = 2.5

L4: Analyze

1. A square column foundation has to carry a gross allowable load of 1805 kN (FS = 3). Given: $D_f = 1.5$ m, $\gamma = 15.9$ kN/m³, $\phi = 34^\circ$ and $c' = 0$. Use Terzaghi's equation to determine the size of the foundation (B). Assume general shear failure.
2. A 6-m-high retaining wall is to support a soil with unit weight $\gamma = 17.4$ kN/m³, soil friction angle $\phi = 26^\circ$, and cohesion $c' = 14.36$ kN/m². Determine the Rankine active force per unit length of the wall both before and after the tensile crack occurs, and determine the line of action of the resultant in both cases.
3. A vertical cut is made in a clay deposit ($c = 30$ kN/m², $\gamma = 16$ kN/m³ and $\phi = 0^\circ$). Find the maximum height of the cut which can be temporarily supported



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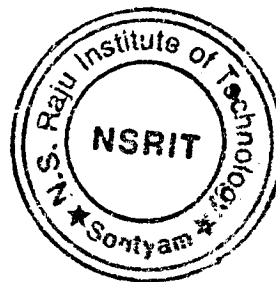
4. A concrete pile of diameter 40 cm is to be driven in stiff clay. Unconfined compressive strength of clay is 180 kN/m^2 . What is length required to be penetrated by the pile to support a safe working load of 350 kN . Take adhesion factor as 0.7. A square foundation is $2 \text{ m} \times 2 \text{ m}$ in plan. The soil supporting the foundation has a friction angle of $\phi' = 25^\circ$ and $c = 20 \text{ kN/m}^2$. The unit weight of soil $\gamma = 16.5 \text{ kN/m}^3$. Determine the allowable gross load on the foundation with a factor of safety (FS) of 3. Assume that the depth of the foundation is 1.5 m and that general shear failure occurs in the soil.

L5: Evaluate

1. As we can take a problem which focused in the south Indian movie, the lead role was an civil engineer planned to construct a project in the area where a small river is present near to the project site, and that site is not good for construction. If you come across this situation as a civil engineer back ground person what idea you can recommend for this problem instead of stopping. (PO6)
2. Same like above in the other film we can observe, the lead role is an college lecturer who is celebrating the Diwali on the same night, piling work is being carried out near to that residential area, due to that piling activity the nearby apartments got down and the total building was collapsed. Later in the investigations it is found that the building was constructed by covering the pond and above that it was build. To overcome this type of situation what type of measures you recommend at the initial stages of construction. (PO8)

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PC 20CE506 Drawing of Reinforced Concrete Structures

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			
		PO1	PO3	PO10	PSO1
20CE506.1	Design principles and Drawing of RC beam as per the IS: 456-2000	2	3	3	2
20CE506.2	Design principles and Drawing of a RC slab as per the IS: 456-2000	2	3	3	2
20CE506.3	Design Principles and Drawing of a RC retaining wall as per the code of practice	2	3	3	2
20CE506.4	Design principles and Drawing of a RC water tank as per the code of practice	2	3	3	2
20CE506.5	Design principles and Drawing of a RC column & footings as per the IS: 456-2000	2	3	3	2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Design and Drawing of a singly reinforced beam
2. Design and Drawing of a doubly reinforced beam
3. Design and Drawing of a Tee beam
4. Design and Drawing of a RC one way slab
5. Design and Drawing of a RC Two way slab
6. Design and Drawing of a Cantilever Retaining Wall
7. Design and Drawing of a Counterfort Retaining Wall
8. Design and Drawing of a short column
9. Design and Drawing of a long column
10. Design and Drawing of a Isolated footing

List of Augmented Experiments

1. Design and Drawing of a Dome
2. Design and Drawing of an Underground Rectangular Water Tank
3. Design and Drawing of an Elevated Water Tank
4. Design and Drawing of stair case
5. Design and Drawing of Pile foundation
6. Design and Drawing of Chimneys

Text Books

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2002
2. Gambhir, M. L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Pvt. Ltd., New Delhi, 2006
3. Subramanian, N., "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2013

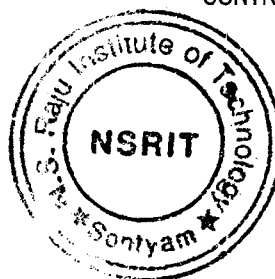
Reference Books

1. Jain, A. K., "Limit State Design of RC Structures", Nemchand Publications, Roorkee, 1998
2. Sinha, S. N., "Reinforced Concrete Design", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2002
3. Bandyopadhyay, J. N., "Design of Concrete Structures", Prentice Hall of India Pvt. Ltd., New Delhi, 2008
4. IS:456-2000, "Code of practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi, 2000
5. SP16, IS:456-1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999
6. Shah, V. L. and Karve, S. R., "Limit State Theory and Design of Reinforced Concrete", Structures Publications, Pune, 2013.

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PC 20CE507 Irrigation Design and Drawing

0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs					
		PO5	PO6	PO10	PO12	PSO1	PSO2
20CE608.1	Understand concept of irrigation and different hydraulic structure	2	2	2	1	1	1
20CE608.2	Recognize the importance, location, components and types of irrigation structures	2	2	2	1	1	1
20CE608.3	Identify various types of irrigation structures and their design aspects	3	2	2	1	1	1
20CE608.4	Examine the drawing of irrigation structures	3	2	2	1	1	1
20CE608.5	Understand the design and drawing of various irrigation structures	3	2	2	1	1	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

Design and Drawing of

1. Barrage
2. Tank sluice with a tower head
3. Tank Surplus weir
4. Canal drop - Notch type
5. Canal regulator
6. Syphon aqueduct type III

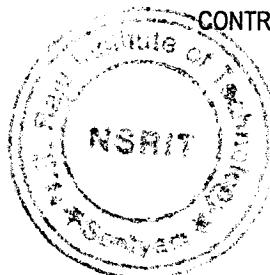
Text Books

1. Satyanarayana Murthy, C., "Water Resources Engineering – Principles and Practice" New age International Publishers, 2020
2. Murthy, R. S. N., "Type Designs of Irrigation Structures", 1st Edition, 1970

Reference Books

1. Garg, Santosh Kumar, "Irrigation Engineering and Hydraulic Structures", 1st Edition, Khanna Publishers, 2006
2. Punmia, B. C. and Lal, "Irrigation and Water Power Engineering", 17th Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 2021

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MC 20MCX03 Intellectual Property Rights and Patents

2 0 0 0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20MCX03.1	Acquire knowledge on intellectual property rights	-	L1,L2
20MCX03.2	Know about the acquisition of trademarks		L1,L2
20MCX03.3	Identify the importance of copyrights, patents and transfer of Ownership		L1, L2
20MCX03.4	Reciprocate on new developments of intellectual property rights		L1, L2
20MCX03.5	International overview of IPR		L1,L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos (L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Intellectual property:

4 Hours

Concepts, types of intellectual property, international organizations, agencies and importance of intellectual property rights. Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR, IPR in India and Abroad

Unit II: Introduction to Trade Marks:

4 Hours

Purpose and function of trademarks, acquisition of trade mark rights, selecting and evaluating trademark, trademark registration processes. Trade Secrets and Industrial Design registration in India and Abroad

Unit III: Registration of Copy Rights

4 Hours

Fundamentals of copy right law, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyright registration, international copyright laws.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Unit IV: Latest development of intellectual property Rights

4 Hours

New developments in trademark law; copy right law, patent law, intellectual property audits. Infringement of IPRs, Enforcement Measures, Emerging issues –

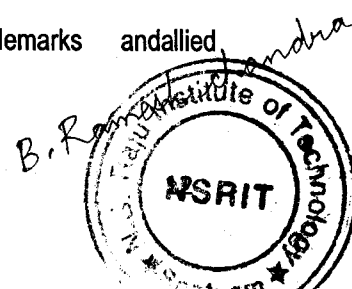
Unit V: Enforcement Of IPRs

4 Hours

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and inter development in trade secrets law.

Text Books

1. Intellectual property right, Deborah, E. Bouchoux, cengage learning.
2. Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli, Tata McGraw Hill Publishing Company Ltd.
3. Cornish, William Rodolph & Lewelyn, David. Intellectual property: patents, copyright, trademarks and allied rights. Sweet & Maxwell, 8/e, 2013.



Reference Books

1. Cornish, William Rodolph. Cases and materials on intellectual property. Sweet & Maxwell, 5/e, 2006.
2. Lo, Jack and Pressman, David. How to make patent drawings: a patent for yourself companion. Nolo, 5/e 2007.

Web References

1. <https://www.investopedia.com/terms/i/intellectualproperty.asp>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/>
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment	Internal Assessment #2
	#1 (%)	(%)
L1	40	40
L2	60	60
Total (%)	100	100

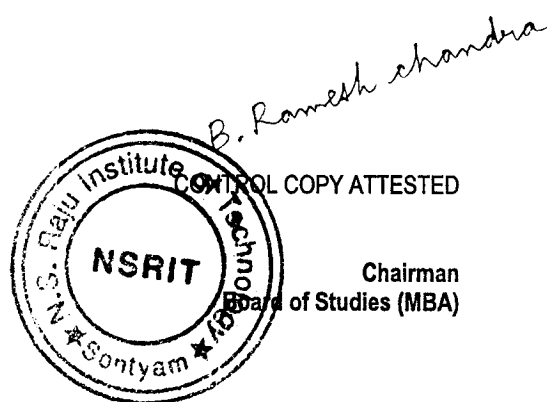
Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Industrial property?
2. What are the fundamentals of copy rights
3. Define patents and its approval process
4. Define copy right law.
5. Define transfer of trade marks.

L2: Understand

1. Explain the role trade secrets in company law.
2. Explain the concept ownership rights of patents with suitable examples
3. Explain the international patent law.
4. Distinguish between copy rights and patents.
5. Explain copy right registration.



IN Summer Internship #1

0 0 0 1.5

At the end of the course, students will be able to

No.	Course Outcomes
1	Demonstrate the theoretical learning outcomes
2	Integrate theory and practice during graduation
3	Comprehend the industry practices in the relevant and allied field of study
4	Develop communication skills in terms of oral, written, and graphical communications
5	Develop problem solving skills
6	Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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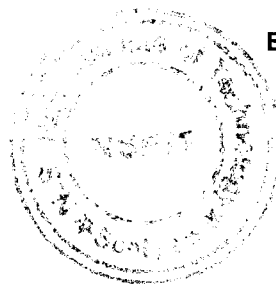
AC Technical Paper Writing**0 0 2 0**

At the end of the course, students will be able to

No.	Course Outcomes
1	Develop searching latest relevant literature pertaining to the topic of interest
2	Develop self-learning ability to become a lifelong independent learner
3	Develop the habit of writing technical manuscript as per the requirement
4	Develop presentation skills and speak with appropriate technical phrases
5	Explore the research topics and develop research interests
6	Comprehend the latest technologies, techniques, tools, and methodologies
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes	

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PC 20CE601 Transportation Engineering

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PSO1	
20CE601.1	Understand the highway and traffic engineering	3	1	3	1	L1, L2
20CE601.2	Identify components of railway engineering and their functions	3	1	3	1	L1, L2
20CE601.3	Understand the planning and classifications of air, docks, portland harbors	3	1	3	1	L1, L2
20CE601.4	Use various design factors of transportation engineering	3	1	3	1	L2, L3, L4
20CE601.5	Interpret the maintenance and controlling of transportation systems	3	1	3	1	L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Understand | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Highway and Traffic Engineering

9 Hours

Necessity for Highway Planning, Different Road Development Plans, Planning Surveys – Highway Alignment- Factors affecting Alignment- Engineering Surveys, types of pavements, Functions and requirements of different components of pavements. Basic Parameters of Traffic, Factors Affecting, LOS Concepts, Road Traffic Signs, Road markings, Types of Intersections.

Highway alignment components of pavement

Unit II: Railway Engineering

9 Hours

Components of Railway Engineering: Permanent way components – Railway Track Gauge – Cross Section of Permanent Way – Functions of various Components like Rails, Sleepers and Ballast – Rail Fastenings – Creep of Rails – Theories related to creep – Adzing of Sleepers- Sleeper density – Rail joints.

Components of railway engineering

Unit III: Airports, Docks and Harbors

9 Hours

Airport Master plan – Airport site selection – Aircraft characteristics – Airport classification – Runway orientation – Wind rose diagram, Runway length – Taxiway design – Terminal area and airport layout. Planning, layout, construction docks & harbors: Classification of ports – Requirement of a good port – Classification of harbors – Docks – Dry & wet docks – Transition sheds and workhouses – Layouts, Quays – Construction of Quay walls – Wharves – Jetties – Tides – Tidal data and Analysis – Break waters – Dredging

Runway length, breakwaters

Unit IV: Geometrical Design

9 Hours

Importance of Geometric Design of highway – Design controls and Criteria of highways, Design of Traffic Signals – Webster Method – IRC Method, Design of Plain, Flared, Rotary and Channelized Intersections Geometric Design of Railway Track: Alignment – Engineering Surveys – Gradients – Grade Compensation, Various Design factors in airports – Design methods, Airport Drainage – Design of surface and subsurface drainage.

Importance of geometrical design, gradient

Unit V: Maintenance of Transportation

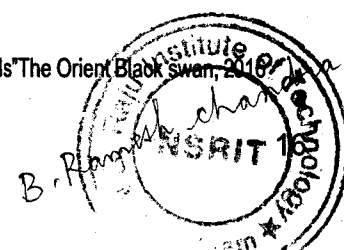
9 Hours

Pavement failures, Maintenance of highways, pavement evaluation, strengthening of existing pavements. Turnouts & controllers, Signal objectives signaling systems – Mechanical signaling system – Electrical signaling system – System for controlling train movement maintenance and rehabilitation of airfield pavements – Evaluation & strengthening of airfield pavements visual aids and air traffic control. Airfield pavement failures, Maintenance of ports, docks and harbors.

Pavement evaluation, strengthening

Text Books

1. Kadyali L. R. and Lal N. B., "Principles and Practices of Highway Engineering", Khanna Publishers, 2006
2. Khanna, S. K., Arora, M. G. and Jain, S. S., "Airport Planning & Design", Nem Chand & Bros., 1999
3. Rao, G. V., "Airport Engineering", Tata McGraw Hill Publishing Co., New Delhi, 1999
4. Srinivasan, R. and Rangwala, S. C., "Harbor, Dock and Tunnel Engineering", Charotar Publishing House, 1995
5. Rangwala, "Airport Engineering", 15th Edition, Charotar Publishing House Pvt. Ltd., 2015
6. Venkatramaiah, C., "Transportation Engineering, Vol. 2: Railways, Airports, Docks and Harbours, Bridges and Tunnels" The Orient Black Swan, 2016



Reference Books

1. Subramanian, K. P., "Highways, Railways, Airport and Harbor Engineering", V Scitech Publications (India), Chennai, 2010
2. Saxena Subhash, C. and Satyapal Arora, "A Course in Railway Engineering", Dhanapat Rai and Sons, Delhi, 1998
3. Khanna, S. K., Arora, M. G. and Jain, S. S., "Airport Planning and Design", Nemachand and Bros, Roorkee, 1994
4. Mannering Fred, L., Kilarski Walter, P. and Washburn Scott, S., "Principles of Traffic Engineering and Traffic Analysis", 3rd Edition, Wiley, 2007
5. Roess, R. P., Prassas, E. S. and McShane, W. R., "Traffic Engineering", 4th Edition, Prentice Hall, 2010

Web References

1. <https://www.iare.ac.in>
2. <https://www.smartworld.com>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	40
L3	20	20
L4	-	5
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any 3 elements in engineering survey.
2. Define the term alignment.
3. Difference between dock and a harbor.
4. What are the basic parameters to be considered in traffic control?
5. Define rotary.

L2: Understand

1. Explain the concept of LOS
2. Discuss the components of railway track formation.
3. Explain the pavement evaluation and strengthening.
4. Explain briefly about Break waters.
5. Write short notes on the ports, Docks & Harbors.

L3 : Apply

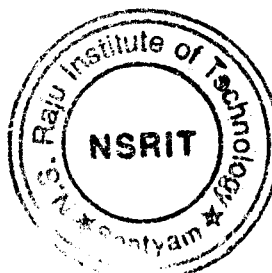
1. Apply the design criteria for a new highway project.
2. Illustrate the use of Webster method for traffic signals.
3. Examine various design factors in airport engineering.
4. Mention how the electrical signaling system function, how it is designed.

L4 : Analyze

1. As a transportation engineer how would you recommend for the pedestrian problem in crossing the road at a busy junction say like Maddilapalem in the Visakhapatnam. As you can observe many accidents are being occurred at that place while crossing.
2. What recommendations can you present for the roads from pendurthi to Aruku route, as there are many pit holes are observed might be because of heavy rains or due to the wear and tear of the vehicle movement. As they can be covered by the patch works but as a technical person how can you suggest to avoid these types of problems.

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PC 20CE602 Design of Steel Structures

3 1 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO3	PO12	PSO 1	
20CE602.1	Analyze and design welded connections	3	1	1	3	L1, L3
20CE602.2	Design simple and compound beams as per IS:800-2007	2	2	1	3	L1, L2
20CE602.3	Design tension and compression members as per IS:800- 2007	3	2	1	3	L1, L2, L3
20CE602.4	Design built-up column and column base systems as per IS:800-2007	2	2	1	3	L1, L2
20CE602.5	Calculate wind forces and design roof trusses	2	2	1	3	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Welded connections

Introduction, Advantages and disadvantages of welding- Strength of welds-Butt and Fillet welds: Permissible stresses – IS Code requirements. Design of Butt weld and fillet weld subjected to moment acting in the plane and at right angles to the plane of the joints.

12 Hours

Types of welds

Unit II: Beams

Introduction to plastic analysis, Design requirements as per IS Code, Design of simple and compound beams-Curtailment of flange plates, laterally supported and unsupported beams.

12 Hours

Plastic analysis

Unit III : Tension Members and Compression Members

General design of members subjected to direct tension, design and strength of angle for tension with bolting and welding. Effective length of columns, Slenderness ratio – permissible stresses, Design of compression members composed of a channel and I sections (Strut members). Design principles of eccentrically loaded columns and splicing of columns.

12 Hours

Slenderness ratio

Unit IV: Built up Columns and Column Bases

Design of built-up compression members made of channel, I section and angles connecting system – Design of lacings and battens. Design of slab base and gusset base. Column bases subjected to axial force and moment

12 Hours

Lacings and Battens

Unit V: Roof Trusses & Industrial Structures

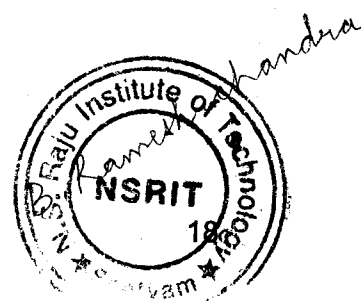
Roof trusses – Roof and side coverings – Design loads, design of purlins and elements of truss; end bearing – Design of gantry girders- analysis of probabilities for different combination of forces and contribution of critical stress.

12 Hours

Load and combinations, gantry girders

Text Books

1. Subramanian, N., "Steel structures (Design & Practice)", Oxford University Press, 2011
2. Duggal, S. K., "Limit State Design of Steel Structures", 2nd Edition, Tata Mc Graw Hill, New Delhi, 2014
3. Bhavikatti, S. S., "Design of Steel Structure by Limit State Method as per IS: 800-2007", 4th Edition, IK International Publishing House, Bangalore, 2014



Reference Books

1. Shah, V. L., Veena Gore, "Limit State Design of Steel Structures", 1st Edition, Structures Publications, 2009
2. Dayaratnam, P., "Design of Steel Structures", 2nd Edition, S. Chand Publishers, 2009
3. Sai Ram, K. S., "Design of Steel Structures", 2nd Edition, Pearson, 2013

Web References

1. design of steel structures nptel - Bing
2. CE2352 DSS.pdf (sasurieengg.com)
3. design of steel structures book - Bing

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	40
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is structural steel design?
2. What are the mechanical properties of structural steel?
3. What are the defects you can expect during inspection of material receiving at the site?
4. What are the types of joints you can use for erection of structural steel?
5. What is minimum thickness of any part of structural steel shape?
6. Write any six features of structural steel
7. What are the cross-section classification defined in IS 800-2007 based on slenderness of plate elements?

L2: Understand

1. Explain the design process of structural steel?
2. Describe the steps used for erection of structural steel?
3. What is the minimum size of bolt used at Astm A32 N?
4. Describe the types of foundations used for columns
5. Explain different types of welds
6. Explain the purpose of lug angles in tension member connection
7. Explain the failure modes of axially loaded columns

L3: Apply

1. Determine the design load capacity of the column ISHB 300@577 N/m if the length of the column is 3m and its both ends are hinged
2. Determine the design forces in the members of a Fink type roof truss for an industrial building for the following data. Overall size of building: 48 m x 16 m, C/c spacing of trusses: 8 m, Rise of truss :1/4 of span, Self-weight of purlins : 318 N/m., Height of columns : 11 m. Roofing : A C sheets (171N/m²), Location : Agra
3. Derive the expression for calculating the force F in a bolt subjected to a factored load P at an eccentricity e. The line of action of the load is in the plane of the bolted connection and the centre of gravity of the connection is the centre of rotation
4. Determine the tensile strength of ISA 125 x 95 x 8 mm connected to the gusset plate of 10mm through the shorter leg by 4, M20 bolts arranged in one row. The grade of steel is Fe410. Take p = 65 mm, Edge & End distance 40 mm

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Board of Studies(CE)

PC 20CE603 Environmental Engineering

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO3	PO6	PO7	PO12	
20CE603.1	Explain the necessity of water supply system and characteristics of water and wastewater	1	2	3	1	L1, L2
20CE603.2	Explain various conveyance system in water supply scheme as per the code SP 35:1987.	3	2	3	1	L1, L2
20CE603.3	Design various units of conventional water treatment plant and water supply system as per IS:10044-1981	2	2	3	1	L2, L3
20CE603.4	Design various units in the wastewater treatment plant as per IS: 2470-1986.	3	2	3	1	L2, L3
20CE603.5	Adapt a treatment unit for the safe disposal of sludge and effluent into the environment	2	2	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Water Demand and Quality

9 Hours

Water Demand - Public water supply system, Planning, Objectives, Design period. Water quality - Development and selection of source, Source water quality, Characterization, Significance, Drinking water quality standards.

Population Forecasting, Water Demand

UNIT II : Conveyance System

9 Hours

Water supply – intake structures – Functions, Pipes and conduits for water – Pipe materials – Types and capacity of pumps – Selection of pumps and pipe materials, pumping and plumbing systems.

Hydraulics of flow in pipes

Unit III: Design of Water Treatment Units

9 hours

Objectives, Unit operations and processes, Principles, functions, design of water treatment plant units, aerators, Coagulation and flocculation, Clariflocculator, Sand filters, Disinfection, Residue Management, Water softening, Construction, Operation and Maintenance aspects.

Desalination process, Membrane filtration

Unit IV: Design of Sewage Treatment Units

9 Hours

Primary treatment - Objectives, Unit operations and processes, Selection of treatment processes, Onsite sanitation - Septic tank, Imhoff tanks, Principles, functions and design of sewage treatment units, Construction, Operation and maintenance aspects.

Secondary treatment - Activated sludge process, Trickling filters, UASB, FAB reactors, Waste stabilization ponds, Other treatment methods, Recent advances in sewage treatment.

Construction, Operation and maintenance aspects

Unit V: Design of Ponds and Sludge Disposal

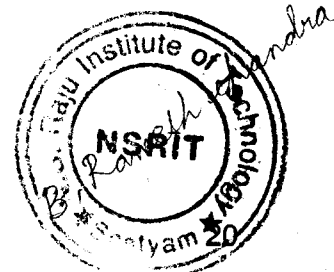
9 Hours

Effluent disposal - Standards for disposal, Methods, dilution, Self-purification of river, Oxygen sag curve, deoxygenation, Land disposal of Sewage. Sludge Disposal - Sludge characterization, Thickening, Sludge digestion, Biogas recovery, Sludge conditioning and dewatering, Sludge drying beds.

Ultimate residue disposal and recent advances, Soil dispersion system

Text Books

1. Punmia B. C., Ashok Jain & Arun Jain, "Water Supply Engineering", Volume I, "Wastewater Engineering", Volume II, 2nd Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2016
2. Birdi G. S., "Water supply and Sanitary Engineering", Revised Edition, Dhanpat Rai & Sons Publishers, 2015
3. Duggal K. N., "Elements of Environmental Engineering", 3rd Edition, S. Chand Publishers, 2010



Reference Books

1. Metcalf and Eddy, "Wastewater Engineering-Treatment and Reuse", Tata Mc.Graw Hill Company, New Delhi, 2010
2. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C., 2010
3. Gray N. F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006

Web References

1. <https://nptel.ac.in>
2. <https://ocw.mit.edu>
3. <https://law.resource.org/pub/in/bis/S02/is.10044.1981.pdf>.
4. <https://law.resource.org/pub/in/bis/manifest.ced.24.html>.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. Define coagulation
 2. Define reverse osmosis
 3. Define oxidation pond
 4. What is the role of skimming tank in STP?
 5. Define standard rate and high rate trickling filter

L2: Understand

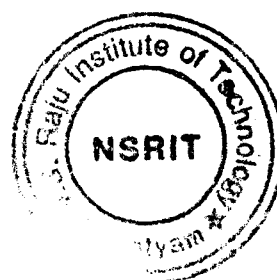
1. Explain the need for supplying protected water supply
2. Differentiate between slow and rapid sand filter with respect to (a). Rate of filtration. (b) Loss of head
3. Explain various factors affecting the water demand
4. Explain the water requirement for domestic and public uses
5. Explain the characteristics of water

L3: Apply

1. Describe the step involved in the design of septic tank. And also explain the working of a trickling filter with neat sketch.
2. If 2% solution of a sewage sample is incubated for 5 days at 20 °C and depletion of oxygen was found to be 5 ppm. Determine the BOD of the sewage
3. Design a rectangular sedimentation tank for treating 4.5 million litres per day adopting L: B ratio as 2, overflow rate 20 m³/d.m² and detention time of 3 hours
4. Design a Sludge digestion tank for 40000 persons. The solids content per day is 0.068 kg/c/d. the moisture of the sludge is 1.02 & 3.5% of the digester volume is daily filled with the fresh sludge, which is mixed with digested sludge
5. Design a primary settling tank (rectangular) for a town having a population of 50,000 with a water supply of 180 l/c/d

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PC 20CE606 Detailing and Drawing of Steel Structures

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO3	PO10	PSO1	
20CE606.1	Apply the basic requirements of the IS design specifications	2	3	3	2	L1, L2, L3
20CE606.2	Design of steel members subjected to compression	2	3	3	2	L1, L2, L3
20CE606.3	Design of flexural members subjected to various loads	2	3	3	2	L1, L2, L3
20CE606.4	Design of plate girders subjected to various loads	2	3	3	2	L1, L2, L3
20CE606.5	Design of column members based subjected to various loads	2	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

List of Experiments

1. Design, Drawing and detailing of bolted and welded connection.
2. Design, Drawing and detailing of members subjected to direct tension, design and strength of angle for tension with bolting and welding.
3. Design of compression members composed of a channel and I sections (Strut members).
4. Design and Drawing of lacings in a column.
5. Design, Drawing and Detailing of Plate girder with the Intermediate stiffeners and end stiffeners.
6. Design, Drawing and Detailing of Column base.
7. Design, Drawing and detailing of gusseted base.
8. Design, Drawing and detailing of gantry girders.

Text Books

1. Krishnaraju, N., "Structural Design and Drawing Reinforced Concrete and Steel", Universities Press, 3rd Edition, 2009
2. Duggal, S. K., "Limit State Design of Steel Structures", Tata Mc Graw Hill Publishing Company, 2005
3. Bhavikatti, S. S., "Design of Steel Structures", Limit State Method as per IS: 800, 2007, IK International Publishing House Pvt. Ltd., 2009
4. Subramanian, N., "Design of Steel Structures", Oxford University Press, New Delhi, 2013

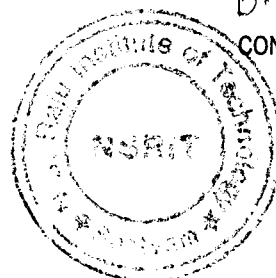
Reference Books

1. Gambhir, M. L., "Fundamentals of Structural Steel Design", Mc Graw Hill Education India Pvt. Ltd., 2013
2. Shiyekar, M. R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd., Learning Pvt. Ltd., 2nd Edition, 2013
3. Narayanan, R., et. al., "Teaching Resource on Structural Steel Design", INS DAG, Ministry of Steel Publications, 2002
4. Shah, V. L., and Veena Gore, "Limit State Design of Steel Structures", IS 800, 2007, Structures Publications, 2009
5. IS 800:2007, General Construction in Steel, Code of Practice, (3rd Revision), Bureau of Indian Standards, New Delhi, 2007

Codes/Tables

IS: CODES-

1. IS -800, 2007.
2. IS - 875.
3. Steel Tables.
4. IS 1367 (PART 3)



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PC 20CE607 Transportation Engineering Laboratory**0 0 3 1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			
		PO1	PO2	PO4	PS02
20CE608.1	Identify engineering properties of aggregate as per IS:2386-1-1963	3	2	2	1
20CE608.2	Identify the grade & properties of bitumen as per IRC-110	3	2	2	1
20CE608.3	Find out peak hour traffic & peak time for a given location on the road as per IRC:009-1972.	3	2	2	1
20CE608.4	Calculate design speed, maximum speed & minimum speed limits of a location through spot speed as per IRC codes.	3	2	2	1
20CE608.5	Draw parking accumulation curve and find out parking duration & turnover of parking lot/stretch as per IRC codes.	3	2	2	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Aggregate crushing value test
2. Aggregate Impact test
3. Specific gravity and Water absorption test
4. Attrition test
5. Abrasion test
6. Shape tests (Flakiness & Elongation Index)
7. Penetration test
8. Ductility test
9. Softening point test
10. Flash and fire point tests
11. Stripping test
12. Viscosity test

List of Augmented Experiments

1. Marshall stability test
2. Traffic volume study at mid blocks
3. Traffic volume studies (Turning movements) at intersection
4. Spot speed studies
5. Earthwork calculations for road works
6. Drawing of road cross sections

Text Books

1. Khanna, S. K., Justo, C. E. G. and Veeraghavan, A., 'Highway Material Testing Manual', 2nd Edition, New Chand Publications, New Delhi, 2016
2. Rao, "Highway Material Testing & Quality Control", 1st Edition, Wiley India Pvt. Ltd., New Delhi, 2015

Reference Books

1. IRC-110 Codes of Practice
2. Asphalt Institute of America Manuals
3. Code of Practice of B.I.S.
4. <https://www.iitk.ac.in/ce/test/IS-codes/is.2386.1.1963.pdf>.
5. <https://www.iitk.ac.in/ce/test/IS-codes/is.383.1970.pdf>.
6. <https://www.civilengineeringnews.tk/p/irc-code.html>

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PC- 20CE608 Environmental Engineering Laboratory

0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			
		PO1	PO6	PO8	PSO1
20CE608.1	Demonstrate how to perform relevant tests in the laboratory to determine the major characteristics of water as per IS: 4251-2004	3	3	2	3
20CE608.2	Make use of various equipment/methods available for examining water and Wastewater as per IS:10044-1981.	3	3	2	3
20CE608.3	Identify the practical significance of the characteristics, the relevant codes of practice for examination and permissible limits for the characteristics of Wastewater following the standards as per IS:10044-1981.	3	3	2	3
20CE608.4	Assess the pollutant concentration in water and wastewater	3	3	2	3
20CE608.5	Choose various treatment techniques for water, wastewater and recycled water	3	3	2	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Determination of pH and electrical conductivity.
2. Determination and estimation of total hardness.
3. Determination of Calcium and Magnesium hardness.
4. Determination of alkalinity.
5. Determination of chlorides in water and soil.
6. Determination and estimation of total solids, dissolved solids.
7. Determination of Iron.
8. Determination of optimum coagulant dosage.
9. Determination of dissolved oxygen with DO Meter & Winkler's Method.
10. Determination of BOD.
11. Determination of COD.
12. Determination of chlorine demand.
13. Determination of Fluorides.

List of Augmented Experiments

1. pH and electrical conductivity value of different samples
2. Estimation of total hardness of bore water
3. Determination of Calcium and Magnesium hardness of bore water
4. Determination of alkalinity and acidity of different samples
5. Determination of chlorides in water and soil
6. Estimation of total solids, dissolved solids in surface water and sub-surface water sample
7. Determination of dissolved oxygen of pond water with DO meter & Winkler's method

Text Books

1. Standard methods for examination of water and wastewater, 23rd Edition, APHA
2. Murali Krishna K. V. S. G., "Chemical Analyses of Water and Soil", 3rd Edition, Reem Publications, New Delhi, 2013

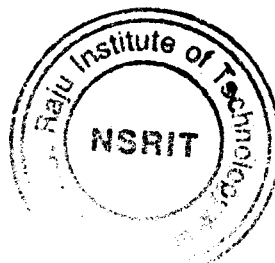
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1. Barani Tharan Balamurali S., "Environmental Engineering Laboratory Manual", 1st Edition, Create space Independent Publishing Platform, 2016

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SC 20CES04 Estimation and Costing

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO11	PO12	
20CES04.1	Determine basic concepts of estimation in evaluating construction cost as per the Method of measurement of civil works framed by Board of Indian Standards	2	3	1	L1, L2, L3
20CES04.2	Apply standard specifications to carry out rate analysis and prepare bar bending schedule for different RC elements.	2	3	1	L1, L2, L3
20CES04.3	Prepare valuation of building using principles of valuation and estimate the quantities for Road work items	2	3	1	L1, L2, L3
20CES04.4	Explain construction organization, construction planning and scheduling of projects	2	3	1	L1, L2, L3
20CES04.5	Design networks using PERT and CPM compose resource planning and optimization	2	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction

12 Hours

General items of work in Building – Standard Units –Principles of working out quantities for detailed and abstract estimates – Methods of Estimates of Buildings – Detailed estimates of buildings.

Prime cost

Unit II: Rate Analysis

12 Hours

Standard specifications for different items of building construction. Rate Analysis – Working out data for various items of work, overhead and contingent charges. Reinforcement bar bending schedule.

Schedule of rates

Unit III: Valuation of Buildings

12 Hours

Purpose and Principles of valuation –Technical terms – Methods of valuation. Estimation of quantities for road work items.

Valuation Methods

Unit IV: Planning, Scheduling and Resource Management for Civil Engineering Project

12 Hours

Objectives of planning – Its advantage to client and engineer – limitations – stages of planning by owner & contractor. Scheduling – definition – its preparation – uses and advantages – classification

Methods of scheduling – bar chart – Job layout – Gantt chart- work breakdown chart (WBC)

Definition – need for resource management – optimum utilization of resources – finance, materials, machinery, human resources – resources planning – resource leveling and its objectives – time –cost trade off crashing – need for crashing an activity – methods & tips for crashing – time vs. cost optimization curve – cost slope – its significance in crashing.

Tender notice, Responsibility of engineer

Unit V: Project Management through Networks

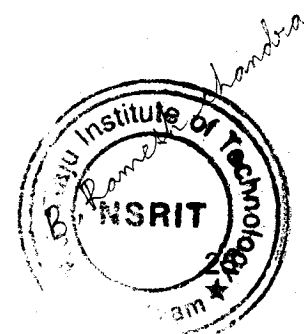
12 Hours

Activity – Event – Dummies – basic assumptions in creating a network– rules for drawing networks – Fulkerson's rule for numbering the events, PERT – time estimates – earliest expected time – latest allowable occurrence time – slack, standard deviation, variance. Precedence networks: Creating network logic, Relationship Types – Finish to Start, start to start, finish to finish, start to finish, critical path method – ES, EF, LS, LF, Floats– significance of critical path.

Activity, Events, Time estimates

Text Books

1. Dutta, B. N., "Estimating and Costing", 10th Edition, UBS Publishers, 2000
2. Chakraborti, M., "Estimation, Costing and Specifications", 7th Edition, Laxmi Publications, 2008
3. Upadhyay, A. K., "Civil Estimating and Costing", 8th Edition, S.K. Kataria and Sons Publishers, 2010
4. Seetharaman, S., "Construction Engineering and Management", Umesh Publications, New Delhi, 2006



Reference Books

1. Birdie, G. S., "Estimating and Costing", 6th Edition, Dhanapati Rai Publishing Company, 2005
2. Standard Schedule of Rates and Standard Data Book by Public Works Department, 2014
3. National Building Code - 2010
4. IS. 1200 (Parts I to XXV – 1974, "Method of Measurement of Building and Civil Engineering works", B.I.S.)
5. IS. 1200 (Parts I to XXV – 1992, "Method of Measurement of Building and Civil Engineering works", B.I.S.)

Web References

1. <https://www.youtube.com/watch?v=IcmigyqQcEw>
2. <https://www.youtube.com/watch?v=ofkpm4lhJcg>
3. <https://easyengineering.net/estimating-costing-book-b-n-dutta-free-downlaod/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	10	10
L2	20	20
L3	30	30
L4	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What do you mean by latest event time?
 2. Write down the unit of 14 mm thick plastering work and reinforcement
 3. Write down the basic essential to draw a network diagram
 4. Enumerate the list of manpower requirement for reinforcement concrete work

L2: Understand

1. Analyze the rate for 3 cm thick cement concrete flooring with (1:4:8). One sq. unit, take 100 sq.m
2. Explain general item of work in building and write down its unit
3. What is the main objective of construction costing and management?
4. What do you mean by analysis of rate? Write down its objective?

L3: Apply

1. What is an estimate? Draw the standard measurement from for detail and abstract estimate and also write down the requirements for estimation
2. Explain general item of work in building and write down its unit
3. A room 300 cm×400 cm has a flat. There is one T beam in the center (C/S below the slab 20 cm×40 cm) and the slab is 12 cm thick. Estimate the quantity required for reinforcement from the data given below. Main bars (8-19 mm diameter in 2 rows of 4 each (All 4 in bottom being straight and other bent) stirrups (8 mm diameter and 18 cm c/c throughout) anchor bar (2- 12 mm diameter bar)

L4: Analyze

1. Estimate the quantity of brick masonry required for construction of a room of 4 m×3 m internal dimensions. Thickness of wall should be 250 mm. is to be provided to the room. Height between top of plinth beam and bottom of slab beam should be 4 m
2. For sanitary and water supply works, what percentage of the estimated cost of the building works are usually provided in an estimate?

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20MCX04 Indian Traditional Knowledge**2 0 0 2**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO6	PO7	PO12	
20MCX04.1	Identify the concept of Traditional knowledge and its importance	1	3	3	2	L1, L2
20MCX04.2	Explain the need and importance of protecting traditional knowledge	1	2	3	2	L1, L2
20MCX04.3	Illustrate the various enactments related to the protection of traditional knowledge	1	3	3	2	L1, L2
20MCX04.4	Interpret the concepts of Intellectual property to protect the traditional knowledge	1	2	3	2	L1, L2
20MCX04.5	Explain the importance of Traditional knowledge in Agriculture and Medicine	1	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

UNIT1: Introduction to traditional knowledge**6hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT2: Protection of traditional knowledge**6hours**

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT3: Legal framework and TK**6hours**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT4: Traditional knowledge and intellectual property**6hours**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT5: Traditional Knowledge in Different Sectors**6hours**

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

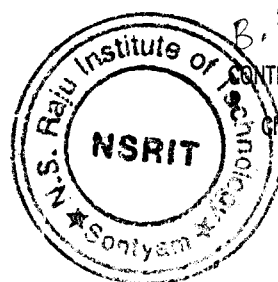
1. Amit Jha, "Traditional Knowledge System in India", 2009.

Reference Books:

1. Amit Jha, "Traditional Knowledge System in India", 2002
2. Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India", CBSE, 2012

Web Links:

1. <https://www.youtube.com/watch?v=LZP1StpYEPm>
2. <http://nptel.ac.in/courses/121106003/>



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PE 20CE001 Advanced Concrete Technology

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE001.1	Categorize the various chemical compositions of cement	-	L1, L2
20CE001.2	Summarize the properties of construction material of fresh and hardened concrete		L1, L2
20CE001.3	Prepare the concrete mix design and recommend the use of construction materials as per IS code for building construction		L1, L2
20CE001.4	Discuss the performance based specifications for durable concrete		L1, L2
20CE001.5	Analyze the thermal, mechanical and micro structural aspects of concrete		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Importance of Bogue's Compounds

12 Hours

Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete, Rheology of concrete in terms of Bingham's parameter.

Elasticity and chemical composition of cement

Unit II: Properties of Concrete

12 Hours

Rheological behavior of concrete, requirements of workability of concrete, Durability & Effect of environmental conditions, Strength & maturity of hardened concrete, Impact, Dynamic and fatigue behavior of concrete, shrinkage and creep of concrete, behavior of concrete under fire.

Hydration in concrete

Unit III: Mix Design

12 Hours

Principles of concrete mix design, Methods of concrete mix design, Standard deviation, Statistical quality control sampling and acceptance criteria.

Factors effecting of mix design, Types of mixes

Unit IV: Permeability and Durability of Concrete

12 Hours

Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing, Hot weather and cold weather concreting, Guniting (Shotcreting)

Abrasion, Deterioration

Unit V: Microstructural Analysis

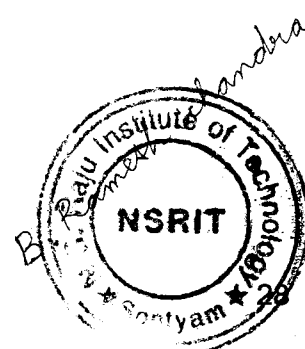
12 Hours

X- Ray Diffraction, Differential Thermal Analysis, Thermo gravimetry Analysis, Atomic Absorption Spectroscopy, Conduction Calorimetry, Potentiometric Methods, X-Ray Fluorescence Analysis, Neutron Activation Analysis, Mossbauer Spectroscopy, Nuclear UV Absorption Spectroscopy, Electron Microscopy, Surface Area, Helium Pycnometry, Microhardness, Mercury Porosimetry, other Techniques and Standards and Specifications.

Porosity, Interfacial Transition Zone

Text Books

- Shetty, M. S., "Concrete Technology", 7th Edition, S. Chand & Company, 2006
- Santha Kumar, A. R., "Concrete Technology", 2nd Edition, Oxford University Press, New Delhi, 2018
- Orchard, D. F., "Concrete Technology", 4th Edition, Elsevier Science & Technology, 1979



4. Neville, A. M., "Properties of Concrete", 5th Edition, Pearson Education, 2013
5. Gambhir, M. L., "Concrete Technology", 5th Edition, K. B. Center, 2010

Reference Books

1. Neville A.M. and Brooks J. J., "Concrete Technology II", 2nd Edition, Trans Atlantic Publications, Philadelphia, USA, 2019
2. Gambhir M. L., "Concrete Technology II", 5th Edition, Tata McGraw Hill Education, New Delhi, 2017
3. IS 10262: 2009, "Recommended Guidelines for Concrete Mix Design II", 2nd Edition, BIS Publication, New Delhi, 2009

Web References

1. <https://www.slideshare.net/justinthesecond/ingredients-and-mixing-concrete>
2. <https://www.slideshare.net/gauravhtandon1/concrete-mix-design-46415349>
3. <https://youtu.be/T4pjWFzd3rA>
4. <https://youtu.be/PpUnxU57vAM>
5. <https://www.slideshare.net/Shanmugasundaramnagaraj/special-concretes-239742583>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	20
L3	20	30
L4	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

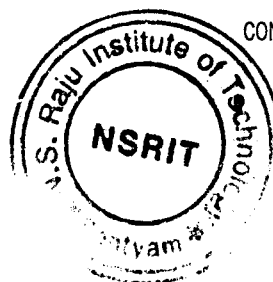
L1: Remember

1. What is the common classification of aggregates?
2. Compare chemical and mineral admixture
3. What is Light weight aggregates?
4. Define curing of concrete
5. Define workability
6. Define creep

L2: Understand

1. Explain in detail of any three tests for fresh concrete
2. Differentiate segregation & bleeding
3. Distinguish between plasticizers and super plasticizers
4. What are the factors affecting workability
5. Discuss the significance of quality control
6. Describe the procedure in adopting ACI method of concrete mix design
7. Explain the factors that influence the choice of mix design

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PE 20CE002 Environmental Geo-technics

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE002.1	Understand the structure of soil and clay mineralogy	-	L1,L2
20CE002.2	Explain the properties of soil and composition of soil		L1, L2
20CE002.3	Describe the characteristics and classification of waste contamination		L2,L3
20CE002.4	Select the methods for disposal techniques/methods		L2, L3
20CE002.5	Implement the control systems and modifications of waste management		L2, L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Clay Mineralogy and Soil Structure

9 Hours

Gravitational and surface forces-inter sheet and inter layer bonding in the clay minerals- Basic structural units of clay minerals- isomorphism substitution – kaolinite mineral- montmorillonite mineral- illite mineral- electric charges on clay minerals – Base Exchange capacity- diffused double layer- adsorbed water- soil structure- methods for the identification of minerals.

Identification of minerals, Soil structure

Unit II: Geotechnical Properties of Soils

9 Hours

Effect of drying on Atterberg limits.-Volume change behavior- factors controlling resistance to volume change- general relationship between soil type, pressure and void ratio.- importance of mineralogical composition in soil expansion. Activity- sensitivity-causes of sensitivity-influence of exchangeable cat ions, pH and organic matter on properties of soils. Permeability of soils- hydraulic conductivity of different types of soils – Darcy's law and its validity- factors affecting permeability.

Volume change behavior, Permeability of soil

Unit III: Wastes and Contaminants

9 Hours

Sources of wastes-types of wastes- composition of different wastes- characteristics and classification of hazardous wastes- ground water contamination- sources - transport mechanisms-potential problems in soils due to contaminants.

Sources of waste, Composition of waste

Unit IV: Disposal and Containment

9 Hours

Criteria for selection of sites for waste disposal- hydrological aspects of selection of waste disposal sites- disposal facilities- subsurface disposal techniques-disposal systems for typical wastes.

Disposal facilities

Unit V: Containment Control Systems

9 Hours

Liners and covers for waste disposal- rigid liners- flexible liners. Ground modification techniques in waste management – waste modification- mechanical modification-hydraulic modification- chemical modification.

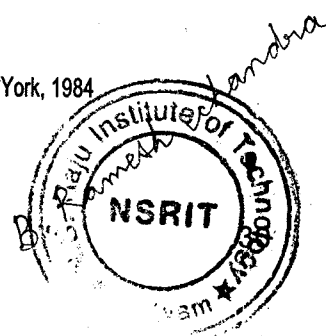
Ground modification

Text Books

1. Mitchel J., " Fundamentals of soil behaviour", John Wiley and sons, New York, 1976
2. Lambe T. W & Whitman R. V., " Soil Mechanics ", John Wiley and Sons, New York, 1979
3. Gopal Ranjan & Rao A. S. R., " Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi, 1991
4. Wilson M. J., "A Hand Book of Determinative methods in Clay Mineralogy", Chapman and Hall, New York, 1987

Reference Books

1. Robert. M. Koerner, "Construction and Geotechnical methods in Foundation Engineering", Mc Graw Hill Book Co., New York, 1984
2. Yong R. N., " Principles of contaminant Transport in Soils, "Elsevier, New York, 1992



3. Ramanatha Iyer T. S., "Soil Engineering Related to Environment", LBS Centre, 2000
4. Daniel B. E., "Geotechnical Practice for Waste Disposal", Chapman and Hall, London, 1993

Web References

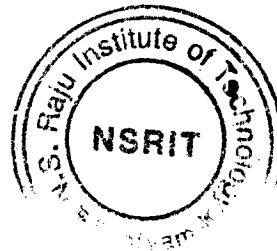
1. <https://nptel.ac.in>
2. <https://www.issmge.org>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. Define the inter layer bonding in the clay minerals
 2. Define base exchange capacity
 3. Classify the clay minerals
 4. List the sources of wastes
- L2: Understand**
1. Explain the factors controlling volume change
 2. Explain the influence of pH and organic matter on soil properties
 3. State Darcy's law
- L3: Apply**
1. Identify and locate the methods of disposal techniques.
 2. Basing on what criteria selection of sites for waste disposal is selected.
 3. How the ground modification techniques can be applied in the waste management.



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PE 20CE003 Transportation Planning and Management

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE003.1	Understand the importance of transportation planning to provide the data required for transportation planning	-	L1, L2
20CE003.2	Demonstrate land use integrated travel demand models		L1, L2
20CE003.3	Understand optimization techniques for transportation systems		L1, L2
20CE003.4	Understand the policy, politics, planning, and engineering of transportation systems in urban areas		L1, L2
20CE003.5	Compare the techniques for planning methodology and transportsystem analysis		L1, L2
Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction of Transportation planning

12 Hours

Introduction - unique importance of transportation, transportation planning methodology, hierarchical levels of planning and its relation to rural, urban areas. Long range planning, passenger and goods transportation, general concept and process of transport planning.

Need of transportation planning

Unit II: Land use and Interaction

12 Hours

Land-use transport interactions, socio - economic characteristics of land use, quick response techniques, Non - transport solutions for transport problems. Characteristics of urban structure. Town planning concepts.

Lowry derivative models, spatial interaction

Unit III: Transportation Systems

12 Hours

Multi modal transportation system - characteristics of mass transit systems including technical, demand operational and economic problems, fixed track facility, mass rapid transit system - elevated, surface and underground construction, Express bus system, integrated operating characteristics of terminal and transfer facilities.

Relationships between nodes, networks, and the demand

Unit IV: Urban Transportation Planning Studies

12 Hours

Urban travel characteristics, private and public behavior analysis, transportation demand surveys, delineation of the urban area, zoning, origin - destination studies, Home interviews, trip classification and Socio - economic variables in trip making projections.

Goals and objectives of urban transportation planning

Unit V: Planning Methodology and System Analysis

12 Hours

Study of existing network - trip generation techniques, category analysis, multiple regression techniques, modal split analysis, trip distribution techniques, growth factor model, gravity models, opportunity models and multiple regression models, minimum path tree - All or nothing assignment and capacity restraint techniques, analysis and evaluation technique.

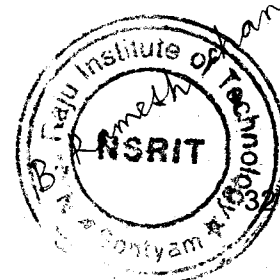
Traffic assessment methods

Text Books

1. Hutchinson, B. G., "Principles of Urban Transport Systems Planning", Scripta, McGraw Hill, New York, 1974
2. Khisty C. J., "Transportation Engineering - An Introduction", Prentice Hall, India, 2002
3. Paquette, R. J., "Transportation Engineering Planning and Design", John Wiley & Sons, New York, 1982
4. Alan Black, "Urban Mass Transportation Planning", McGraw Hill, 1995

Reference Books

1. Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2011
2. Khanna, S. K. and Justo C. E. G., "Highway Engineering", New Chand Publications, 2008



3. Flaherty, C. A. O., "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA, 2006
4. Papacostas, C. S. and Prevedouros, P. D., "Transportation Engineering and Planning", Prentice Hall of India Pvt. Ltd., 2001

Web References

1. <https://www.digimat.in/nptel/courses/video/105106058/L37.html>
2. <http://www.digimat.in/nptel/courses/video/105106058/L33.html>
3. <https://users.pfw.edu/sahap/CE450%20Transport%20Policy%20and%20Planning/1.%20Lectures/Books,%20references,%20readings/Transportation%20Planning%20Handbook%20Forth%20Edition.pdf>
4. <https://youtu.be/pW-Qymxabsc>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

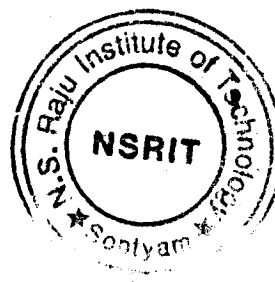
L1: Remember

1. What is regional transport planning?
2. Define the early land use transport models
3. Describe the land use and transportation

L2: Understand

1. Mention about construction equipments and also indicate the place of use
2. Classify the transport planning methodologies
3. Explain the national urban transport policy

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PE 20CE004 Water Resources Systems Planning and Management

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CES04.1	Interpret the concepts of optimization	-	L1, L2
20CES04.2	Explain the concepts of linear programming		L2, L3
20CES04.3	Summarize the concepts of dynamic programming		L2, L3
20CES04.4	Explain the concepts of Non-linear programming		L2, L3
20CES04.5	Explain the concepts of Non-linear programming		L2, L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction

9 Hours

Concepts of systems analysis, definition, systems approach to water resources planning and management, role of optimization models, objective function and constraints, types of optimization techniques.

Roles of optimization

Unit II: Linear Programming

9 Hours

Formulation linear programming models, graphical method, simplex method, duality in linear programming, application of Linear programming in water resources

Applications of linear programming

Unit III: Dynamics Programming

9 Hours

Belman's of principles of optimality forward and backward recursive dynamic programming, case of dimensionality, application of dynamic for resource allocation.

Resource allocation

Unit IV: Non-Linear Optimization Techniques

9 Hours

Clerical method of optimization, Kuch-Tucker condition, gradiental based research techniques for simple unconstrained optimization.

Non Linear application

Unit V: Water Resources Management

9 Hours

Planning of reservoir system, optimal operation of single reservoir system, allocation of water resources, optimal cropping pattern, conjunctive use of surface and sub-surface water resources.

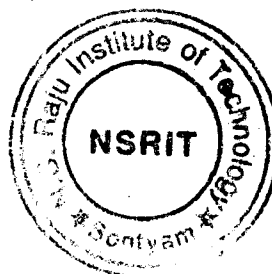
Strategies for water resources impacts

Text Books

1. Vedula, S., and Majumdar, P. P., "Water Resources Systems – Modeling Techniques and Analysis", Tata McGraw Hill, 5th reprint, New Delhi, 2010
2. Rao, S. S., "Engineering Optimization, Theory and Applications", 3rd Edition, New Age International Publication, New Delhi, 2010

Reference Books

1. Taha, H. A., "Operation Research", McMillan Publication Co., New York, 1995
2. Chadurvedi, M. C., "Water Resource Systems Planning and Management", Tata McGraw Hill Inc., New Delhi, 1997
3. Bhawe, P. R., "Water Resources Systems", Narosa Publishing House, New Delhi, 2011



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Web References

1. NPTEL :: Civil Engineering - Water Resources Systems Planning and Management
2. Introduction - YouTube
3. Linear Programming: Graphical method - YouTube

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What is water resources management?
 2. What is simulation and what are the steps in simulation?
 3. What are the challenges of managing the water cycle?
 4. What is a linear programming problem?
 5. What are the five basic requirements of linear programming?

L2: Understand

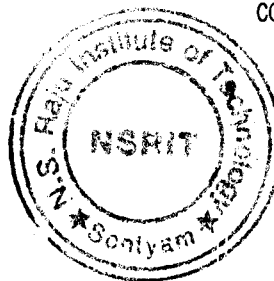
1. Describe about the role of optimization models
2. Discuss the concept of systems analysis
3. Discuss the various applications of linear programming in water resources
4. Describe about backward recursion and forward recursion with neat diagrams
5. Explain the Kuhn-Tucker conditions and also specify the necessary (or) minimum

L3: Apply

1. Choose the different types of simulation and any one application of simulation in water resources
2. Articulate the following terms (i) Benefit Cost Analysis (ii) Pricing of water resources
3. Determining the optimal cropping pattern
4. Choose the various advantages of conjunctive use of surface and sub-surface water resources

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PE 20CE005 Construction Equipment Automation

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE005.1	Understand the equipments & automation and key features of its performance	-	L1, L2
20CE005.2	Understand the feasibility of specific equipment in different project conditions		L1, L2
20CE005.3	Understand the equipment and appliances required for the different phases of concrete road construction		L1, L2
20CE005.4	Understand the automation techniques in construction industry		L1, L2
20CE005.5	Understand the innovations in automation systems in detail,including benefits of robotics versus conventional construction equipment		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Construction Equipment

12 Hours

Introduction - Unique features of construction equipment, Need of construction equipment - specification reading, construction scheduling and estimating, Job layout and its importance. Study of equipments with reference to available types and their capacities, factors affecting their performance. feasibility, Owning and operating cost and productivity of different equipment – Excavators, pavers, Plastering Machines – Pre stressing Jacks and grouting equipment – Cranes and hoists etc.

Advantage of construction equipment, Excavators

Unit II: Construction Equipment Management

12 Hours

Equipment Management- Introduction, Differences between men and manpower, Extent of Mechanization, Equipment planning, Selection of equipment, Forward planning, Purchase of Equipment, Specifications for ordering equipment

Monitoring, scheduling

Unit III: Equipment for Concrete and Road laying

12 Hours

Aggregate production equipment- Different Crushers – Feeders - Screening Equipment -Handling Equipment - Batching and Aggregate Mixing Equipment - Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment – Ready mix concrete equipment, Concrete mixers, Concrete batching and mixing plant, Transportation of concrete mix, Concrete pouring and pumps, concrete compaction equipment.

Concrete manufacturing process, workability, factors

Unit IV: Automation in Construction Industry

12 Hours

Need and benefit of Automation – Applications, Automation in canal lining, Automation in Construction of Highway, Automation in concrete technology. Drones- Photogrammetric, drones to survey working areas, Structural health monitoring, under water survey.

Surveying, advantage of automation system

Unit V: Robotics In Construction

12 Hours

Introduction, Benefits of robots in construction industry with respect to time, cost, quality, safety. Use of robots for construction activities like – Brick laying, Demolition, Material handling, Structural steel cutting, Rebar tying or bending, form work, mould making, 3D printing, Automation in prefabrication of masonry and on site masonry construction, automated manufacture of brickwall masonry blocks, Automation in timber construction, Automation in production of steel components.

Automation in high-rise building construction, Advantages of robotics

Text Books

1. Peurifoy, R. L., Ledbetter, W. B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006
2. Sharma, S. C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988



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3. Deodhar, S. V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988

Reference Books

1. Mahesh Varma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi, 1983
2. John E. Schaufelberger, Giovanni C. Migliaccio, "Construction Equipment Management", 2nd Edition, Published March 15, 2019
3. Bock Thomas, "Hybrid Construction Automation And Robotics", 24th International Symposium on Automation & Robotics in Construction (ISARC 2007) Construction Automation Group, I.I.T. Madras, 2007

Web References

1. <http://cdn.intechopen.com/pdfs-wm/5555.pdf>
2. (PDF) Construction plant and equipment management research: thematic review (researchgate.net)
3. NPTEL :: Civil Engineering - NOC:Construction methods and equipment management
4. <https://www.slideshare.net/ShankarRamasamy3/ctep-unitv-construction-equipments-ppt>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

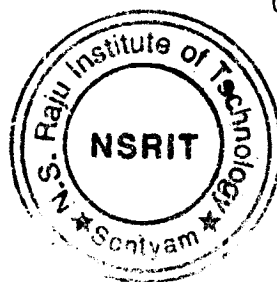
- L1: Remember
1. What is need of construction management?
2. What are the benefits of robotics in construction industry?
3. Illustrate the uses of bulldozers on construction projects
4. Describe the selection factors for rear dump trucks
5. Describe the process of structural steel cutting by using automation technique

L2: Understand

1. Classify construction equipments on different basis with suitable examples
2. Classify the excavation equipments
3. Discuss objectives of construction management
4. Explain the process of timber construction with automation

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PE 20CE006 Harbor Engineering

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE006.1	Understand the basics of harbor engineering and marine environment		L1, L2
20CE006.2	Explain the types of ports and harbors and the methods for estimation		L1, L2
20CE006.3	Interface between water and land infrastructure and harbor planning		L2, L3
20CE006.4	Determine the shape and size of harbor and turning basin		L2, L3
20CE006.5	Identify the harbor problems and management issues		L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to oceanography

9 Hours

Introduction, Ocean Circulation, Tides, Waves, Currents, Tsunami and Storm surges – origin, generation, propagation and characteristics; Different materials for marine applications - metals, concrete, geo synthetic products and other materials for marine environment.

Oceanography, origin and generation

Unit 2: Types of ports and harbors

9 Hours

Types, harbor layout and terminal facilities - piers, break waters, wharves, jetties, quays; Spring fenders, dolphins and floating landing stage environmental issues in port planning and operations; Harbor oscillations, seiches; Inlets – siltation of inlets and harbors – remedial measures; Onshore and offshore sediment transport - transport rate – estimation methods.

Harbor layout, transport rate

Unit 3: Ports and harbors

9 Hours

Ports and harbors as the interface between the water and land infrastructure- an infrastructure layer between two transport media- History of port growth- factors affecting growth of port - Classification of harbor planning, justification, volume and commerce of a port.

Classification of harbor planning

Unit 4: Size and shape of harbor and turning basin

9 Hours

Type, location and height of Breakwaters – Location and width of entrance to harbor – Depth of harbor and navigational channel – Number, location and type of docks or berths or jetties- Shore facilities for Marine terminals and fishing harbors.

Marine terminals and fishing harbor

Unit 5: Coastal and harbor management issues

9 Hours

Population growth and urbanization-coastal use-resource exploitation-fisheries-forestrygas-mining-infrastructure-transportation-shore protection-defence-Impact of human use-pollution-industrial waste sewage-administration and legal issues, Marine corrosion and control. Physical modeling of coastal and offshore and harbor engineering problems

Impact of human use, industrial waste sewage

Text Books

1. Ozha & Ozha, "Dock and Harbor Engineering", 1st Edition, Charotar Books, Anand, 1990
2. Dean, R. G. and Dalrymple, R. A., "Water wave mechanics for Engineers and Scientists", Prentice-Hall, Inc., EnglewoodCliffs, New Jersey, 1994
3. Ippen, A. T., "Estuary and Coastline Hydrodynamics", McGraw Hill Book Company, Inc., New York, 1978
4. Sorenson, R.M., "Basic Coastal Engineering", A Wiley-Interscience Publication, New York, 1978



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Reference Books

1. Muir Wood, A. M., and Fleming, C. A., "Coastal Hydraulics Sea and Inland Port Structures", 1st Edition, Hallstead Press, 2002
2. Seetharaman, S., "Construction Engineering and Management", 4th Edition, Umesh Publications, New Delhi, 1999
3. Richard L. Silister, "Coastal Engineering Volume I & II", Elsevier Publishers, 2000
4. PeraBrunn, "Port Engineering", 1st Edition, Gulf Publishing Company, 2001

Web References

1. <https://nptel.ac.in>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List different materials used for marine applications.
2. Define transport rate.
3. List source of the special types of break water

L2: Understand

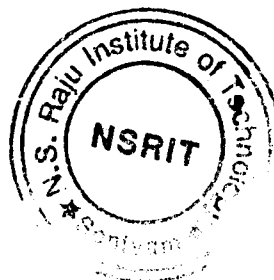
1. What is the most popular method of construction of wall breakwaters?
2. Discuss briefly about the classification of harbor planning
3. Explain about the physical modeling of harbor engineering problems
4. Discuss in detail about the environmental concern required for port operation

L3: Apply

1. Compare a port and a harbor. What would be the requirements of good port
2. Differentiate the harbors on broad basis and on the basis of utility
3. Classify harbor based on location.
4. Discuss the factors to be considered while selecting a suitable site for the construction of a port

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PE 20CE007 Pre stressed Concrete Structures

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE007.1	Understand the materials required and pre-stressing Systems as per the IS 7861-2:1981(R2002).		L1, L2
20CE007.2	Calculate the loss of pre-stress and analyze stresses in pre-stressed section as per the IS 7861-2:1981(R2002).		L1, L2
20CE007.3	Design the section for flexure and shear as per the IS 7861-2:1981(R2002).	-	L1, L2, L3
20CE007.4	Design basic elements of steel structure like tension members, compression members as per the IS 7861-2:1981(R2002).		L1, L2, L3
20CE007.5	Analyze and design the composite structural members and principle techniques for the design of circular pre stressing as per the IS 7861-2:1981(R2002).		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Principles of Pre stressing

12 Hours

Types and Systems of Pre stressing, Need for High Strength Concrete and High Tensile Steel – Types of Tensioning - Analysis of Sections for Stresses by Stress Concept, Strength Concept and Load Balancing Concept – Short and long term Deflection – Losses in pre stressing, Camber, Cable Layouts.

Stress-strain characteristics of materials and properties

Unit II: Analysis and Design of Flexural Members

12 Hours

Behavior of Flexural Members - Determination of Ultimate Flexural Strength – IS: 1343 Codal Provisions - Design of Flexural Members, Design for Combined Bending, Shear and Torsion, Design of End block.

Anchorage zone reinforcement

Unit III: Indeterminate Structure

12 Hours

Analysis and Design of Continuous Beams - Methods of Achieving Continuity – Concept of Linear Transformations, Concordant Cable Profile and Cap Cables.

Analysis of simple portal frames

Unit IV: Design of tension and Compression Members

12 Hours

Design of Tension Members - Application in the Design of Pre stressed Pipes and Pre stressed Concrete Cylindrical Water Tanks - Design of Compression Members – Application in the Design of Columns and Piles.

Design of railway sleepers, Poles

Unit V: Design of Composite Members and Circular Pre stressing

12 Hours

Composite Beams - Analysis and Design, Ultimate Strength - their Applications. Partial Pre stressing– its Advantages and Applications.

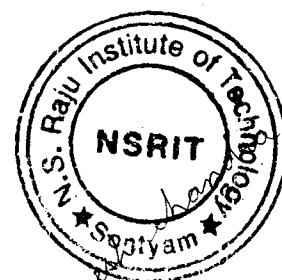
Prestressed concrete shells and folded plate structures

Text Books

1. Pandit, G.S., and Gupta, S. P., "Pre stressed Concrete", CBS Publishers and Distributors Private Limited., 2019
2. Krishna Raju, N., "Pre stressed concrete", 6th Edition, Mc Graw Hill Education (India) Private Limited., 2018
3. Dayaratnam, P., "Pre stressed Concrete Structures", Oxford and IBH, 2013
4. Lin, T. Y., "Design of Pre stressed Concrete Structures", 3rd Edition, Wiley India Pvt. Ltd., 2010

Reference Books

1. Mallic. S. K. and Gupta A. P., "Pre stressed Concrete", Oxford and IBH Publishing Co. Pvt. Ltd., 1997
2. Sinha, N. C. and Roy, S. K., "Fundamentals of Pre-stressed Concrete", 3rd Edition, S. Chand & Company Limited, 2011



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3. Rajagopal, N., "Pre stressed Concrete", Narosa Publishing House, 2nd Edition, 2005
4. IS 1343:2012, Code of Practice for Pre stressed Concrete, Bureau of Indian Standards, New Delhi, 2012
5. IS 3370- Part 4 (2008) Indian standard Code of practice for concrete structures for the storage of liquid- Design tables, code of practice, Bureau of Indian standards, New Delhi

Web References

1. <https://nptel.ac.in/courses/105/106/105106118/>
2. <https://youtu.be/4KYPltsNAWs>
3. https://youtu.be/HWEHikKH_Q

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	20	20
L4	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the advantages of PSC construction?
2. What is meant by pressure line?
3. Define bonded and unbonded pre stressing concrete
4. What is concordant pre stressing?
5. What are the grades of concrete to be used in pre tensioned and post tensioned works?

L2: Understand

1. Explain the axial pre stressing
2. Explain about the various methods of pre stressing the concrete
3. Discuss the measures to be adopted for counteracting elastic loss and friction loss in case of post tensioned members
4. Describe the term Hoyer effect on pre tensioned elements
5. Explain how the friction loss in curved tendons could be reduced in post tensioned members

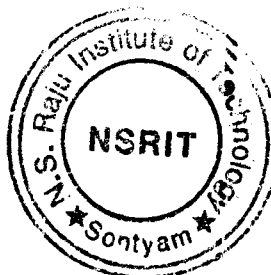
L3: Apply

1. Sketch the strain and stress / force diagram of a pre stressed concrete beam section under collapse
2. Illustrate the various losses in pre stress
3. Demonstrate any two advantages in partial pre stressing
4. State the reasons for which high tensile concrete is necessary in pre stressed
5. Compare pretension and post tension
6. Mention the factors influencing deflection
7. Differentiate bonded and un bonded tendons
8. Contrast about concordant cable

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PE 20CE008 Environmental Impact Assessment

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE008.1	Understand the concept of Environmental Impact Assessment	-	L1,L2
20CE008.2	Select an appropriate EIA methodology		L1, L2
20CE008.3	Identify the impacts of developmental activities		L2,L3
20CE008.4	Outline the assessment on the the impacts of EIA components		L2, L3
20CE008.5	Identify the risks and impacts of a project		L2, L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create, DoK: Depth of Knowledge			

Unit 1: Concept of EIA

9 Hours

Introduction, Elements of EIA, Factors affecting EIA, Stages in EIA, Life Cycle Analysis, Preparation of environmental base map, Classification of environmental parameters, Role of stakeholders in the preparation of EIA

Elements and factors affecting EIA

Unit 2: EIA Methodologies

9 Hours

Criteria for selecting EIA methodology, Methods of EIA, Adhoc method, Matrix method, Network method, Overlay method, Environmental media quality index, Cost benefit analysis, EIS & EMP

Cost benefit analysis

Unit 3: Impacts of Developmental Activities

9 Hours

Introduction, Land use, Assessment of soil and ground water, Delineation of study area, Identification of activities, Applications of RS & GIS for EIA.

Land use, Soil composition and properties

Unit 4: Assessment of Environmental Components

9 Hours

Introduction, Impact identification, Prediction and significance, Assessment of EIA with reference to surface water, Air environment, Biological environment, Vegetation, Wild life. Impacts of deforestation.

Components of EIA

Unit 5: Risk Assessment, EIA Notification

9 Hours

Risk assessment - Environmental risk assessment and management in EIA, Treatment of uncertainty, Key stages in risk assessment, Advantages of risk assessment. EIA notification - Provisions in EIA notification, Environment clearance, Evaluation of EIA report, Environment legislation, Evaluation of audit plan, Audit report preparation, Post audit activities, ISO, ISO 1400.

Risk and Hazards, Environmental clearance

Text Books

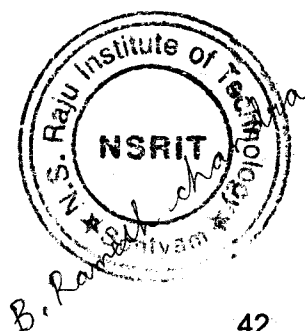
1. Larry. W. Canter, "Environmental Impact Assessment", 2nd Edition, MC Graw Hill Series, India, 1995
2. Anjaneyulu Y. "Environmental Impact Assessment Methodologies", 2nd Edition, CRC Press, 2011

Reference Books

1. Suresh K. Dhameja, "Environmental Science and Engineering", Reprint Edition, S K Kataria and Sons, 2013
2. David Laurance, "Environment Impact Assessment", Wiley Publications, 2003

Web References

1. <https://nptel.ac.in>
2. <https://www.iitr.ac.in>
3. <http://www.gpcet.ac.in>



Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. Define EIA
 2. What are the criteria for selecting EIA method?
 3. Define land use
 4. List the components of EIA
 5. Define Life Cycle Analysis

L2: Understand

1. Explain about risk assessment and management
2. Explain the methodology for air environment.
3. Explain the factors affecting EIA
4. Explain the significance of EIA
5. Explain about cost benefit analysis

L3: Apply

1. How do you identify key environmental issues during EIA studies
2. Some steps in the EIA process have proved to be more difficult to implement than others. From your initial reading, identify which these might be and consider why they might have proved to be problematic
3. Write down the sort of recommendations you would make to ensure that impact predictions will be auditable

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PE 20CE009 Pavement Analysis and Design

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE009.1	Outline pavement design principles and traffic consideration	-	L1, L2
20CE009.2	Explain about material characterization		L2
20CE009.3	Analyze and design flexible pavement		L2, L3
20CE009.4	Analyze and design concrete pavement		L2, L3
20CE009.5	Evaluate pavement evaluation techniques and overlay design		L1, L2, L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Principles of Pavement Design

12 Hours

Types of Pavements, Concept of pavement performance, Structural and Functional failures of pavements. Different types of pavement performance criteria. Different pavement design approaches. General framework for pavement design.

Traffic Considerations in Pavement Design: Vehicle types. Axle configurations. Contact shapes and contact stress distributions. Concept of standard axle load. Vehicle damage factor. Axle load surveys. Lateral placement characteristics of wheels. Estimation of design traffic.

Unit II: Pavement Material Characterization

12 Hours

Identification of different material inputs required for analysis and design of pavements. Selection of appropriate conditions (temperature, moisture content, loading time, etc) for characterizing pavement materials. Brief description of the principles of different laboratory and field methods adopted for characterizing pavement materials. Elastic, Non-elastic & Visco-elastic.

Unit III: Design of Flexible Pavements

12 Hours

Selection of appropriate theoretical models for analysis of flexible and concrete pavements, analysis of layered flexible pavement systems using linear elastic layered theory. Discussion of the need for use of advanced analytical techniques for flexible pavements. Discussion of different softwares available for analysis of flexible pavements.

Flexible Pavement Design Methods: Detailed discussion of different methods of design of flexible pavements. Indian Roads Congress guidelines - IRC:37: American Association of State High and Transport Officials (AASHTO) - 1993 method. TRRL Design method, brief discussion of salient features of the AASHTO 2002 draft design guidelines for flexible pavements. Comparison of design concepts adopted in different approaches. Comparison of original & revised versions of codes.

Unit IV: Analysis of Concrete Pavements

12 Hours

Discussion of different theoretical models for analysis of different types of concrete pavements. Analysis of wheel load stresses, curling/warping stresses due to temperature differential, critical stress combinations. Discussion of the need for use of advanced analytical techniques for concrete pavements.

Concrete Pavement Design Methods: Detailed discussion of different methods of design of concrete pavements. Indian Roads Congress guidelines - IRC:58. American Association of State High and Transport Officials (AASHTO) - 1993 method, PCA method, Concept of Continuously Reinforced Concrete Pavement, Brief discussion of salient features of the AASHTO 2002 draft design guidelines for concrete pavements. Comparison of design concepts adopted in different approaches. Comparison of original & revised versions of codes.

Unit V: Pavement Evaluation Techniques

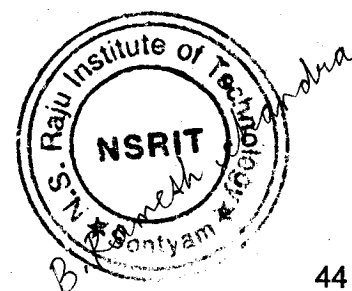
12 Hours

Functional and structural evaluation of pavements, concept of roughness, international roughness index, measurement of roughness using different types of equipment. structural evaluation of in-service pavements using benkelman beam and falling weight deflectometer methods.

Pavement Overlay Design Methods: Overlay design as per Indian Roads Congress guidelines (IRC:81). Overlay design as per AASHTO-1993 guidelines.

Text Books

1. Yang H. Huang, "Pavement Analysis and Design", Pearson Education, 2004
2. Yoder, E. J. and Witzak, M. W., "Principles of Pavement Design", John Wiley & Sons, 1st Edition, 1975



Reference Books

1. Animesh Das, "Analysis of Pavement Structures", 1st Edition, CRC Press, 2014
2. Khanna, S. K. and Justo, C. J., "Highway Engineering" Nemchand & Bros., 7th Edition, 2000
3. Kadiyali, L. R. and Lal, N. B., "Principles and Practices of highway Engineering", 2003

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1. <https://nptel.ac.in/content/storage2/courses/105104098/TransportationII/recap/6-recap.htm>
2. <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-19.pdf>
3. https://www.youtube.com/watch?v=5zKC_aq4ypM&list=PLSitSeMkk1bndRgMKgVtl64pallKUVuH

Indian Standard Codes

1. IRC Code for Rigid pavement-IRC-58-2002
2. IRC Code for Flexible pavement-IRC-37-2001

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the main design factors to be considered for flexible pavement design?
2. What are the characteristics of good pavement?
3. What is the Serviceability Index of present pavements?
4. What is the structural condition of pavement?
5. What is the most common used concrete pavement?

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. What determines joint intervals in jointed unfurnished concrete pavement?
3. Write comparison between flexible and rigid pavements

L3: Apply

1. A two lane two way carriageway carries a traffic load of 1500 cvd. The rate of growth of traffic is 5% per annum. The design life is 5 years. The vehicles damage factor is 2.5. CBR value of soil is 7%. Calculate a) Cumulative number of standard axles to be used in the design b) Total pavement thickness c) composition of the pavement
2. Calculate the stresses at interior, edge and corner regions, of a concrete pavement using Westergaards stress equation for the following data:
Wheel load = 4100 kg/tyre
Modulus of elasticity of concrete = 3.3×10^5 kg/cm²
Pavement thickness = 18cm, Modulus of sub grade reaction = 2.5 kg/cm³ Diameter of loaded area = 25 cm, Poisson's ratio of concrete = 0.15



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PE 20CE010 Urban Hydrology**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE010.1	Recall the basics of the hydrology	-	L1,L2
20CE010.2	Analyze urban storm water systems, urban precipitation and Storm water runoff		L1,L2
20CE010.3	Identifying the quantity of impacts for the climate change on shortduration with high intensity rainfall in urban areas.		L1,L2, L3
20CE010.4	Organizing the flood problems in Urban areas.		L1,L2, L3
20CE010.5	An exposure to the urban water cycle is also provided.		L1,L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction**9 Hours**

Review of basic hydrology, Storm water runoff generation, Return period, Hydrologic risk.

*Storm water runoff generation***Unit II: Precipitation Analysis****9 Hours**

Frequency analysis, IDF relationships, Design storm, Open channel flow in urban watersheds, Interception storage.

*Channel flow in watersheds***Unit III: Watershed Management****9 Hours**

Estimation of runoff rates from urban watersheds, Flow routing.

*Runoff estimation***Unit IV: Management****9 Hours**

Storm water drainage structures, Storm water detention, Structural and non-structural control measures, Source control techniques.

*Drainage Structures***Unit V: Master Drainage Plans****9 Hours**

Issues to be concentrated upon – typical urban drainage master plan, interrelation between water resources investigation and urban planning processes, planning objectives, comprehensive planning, use of models in planning.

*Water resource investigation and planning process.***Text Books**

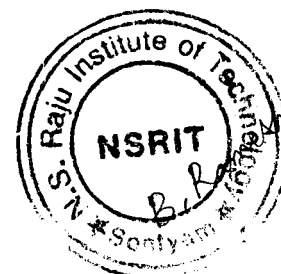
1. Butler, D. & Davies, J. W., "Urban Drainage", Spon Press, 2nd Edition, 2004
2. Akan A.O. and Houghtalen R. J., "Urban Hydrology, Hydraulics and Stormwater Quality Engineering"

Reference Books

1. "Applications and Computer Modeling", John Wiley & Sons, 2003
2. Hall, M. J., "Urban Hydrology", Elsevier, 1984
3. Shaw, E. M., "Hydrology in Practice", 3rd Edition., Chapman & Hall, 1994

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1. <https://nptel.ac.in/courses/>
2. <https://www.youtube.com>
3. <https://www.ott.com/applications/urban-hydrology-3/>



1. <https://nptel.ac.in/courses/>
2. <https://www.youtube.com>
3. <https://www.ott.com/applications/urban-hydrology-3/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

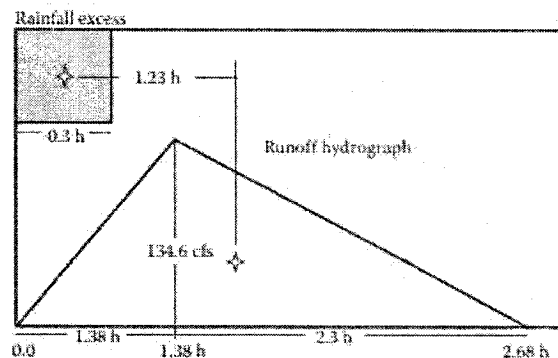
1. List out different forms of precipitation and explain in brief
2. Define Length of waterway
3. Relationship between basin lag and watershed parameter.
4. Write a short note on Man hole.
5. Give procedure for determination of the ϕ - index

L2: Understand

1. Explain the procedure for determination of runoff using curve number method.
2. Illustrate different flood control measures along with their suitability.
3. What are the governing factors for the layout of a storm sewer system?
4. What is the purpose of the Man holes in the sewer pipe lines.
5. Explain the objectives of watershed management.

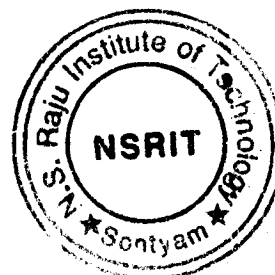
L3: Apply

1. Build the 5-min unitgraph by the CUHP for the watershed with the following parameters: $A = 0.38 \text{ mile}^2$, $L = 1.28 \text{ mile}$, $L_c = 0.52 \text{ mile}$, $I_a = 44\%$, and $S_o = 0.0102 \text{ ft/ft}$.
2. Derive the SCS triangular unitgraph for the rural watershed with the following parameters: $D = 0.3 \text{ h}$, $A = 0.38 \text{ mile}^2$, $L = 1.28 \text{ mile}$, $L_c = 0.52 \text{ mile}$, $CN = 85$ for south-west desert urban areas, and $S_o = 0.0102 \text{ ft/ft}$.



3. Explain the procedure for the design of stormwater network.
4. What is the interrelation between water resources investigation and urban planning processes?

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PE 20CE011 Sustainable Construction Methods

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE002.1	Understand the energy conservation methods and their factors	-	L1, L2
20CE002.2	Understand the concept and strategies of environmental impact of building materials		L1, L2
20CE002.3	Explain the innovative sustainable construction materials and their uses in construction		L1, L2
20CE002.4	Summarize the various energy efficient materials and sustainable construction technology		L1, L2
20CE002.5	Discuss the various energy efficient construction technologies		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction and Energy Conservation methods

12 Hours

Energy Conservation – Recourse Consumption – Introduction – Distribution of Energy use in India – Factors affecting the Energy use in Buildings – Pre-Building Stage, Construction Stage & Post Occupancy stages – Concept of Embodied Energy – Energy needs in Production of Materials – Transportation Energy – Concept of light footprint on Environment.

Energy efficiency

Unit II: Environmental Impact of Building Materials

12 Hours

Measuring the impact of building materials; calculating embodied energy, recycling and embodied energy, processing and embodied energy, time and embodied energy, embodied energy of different building materials, low energy building and masonry materials, life cycle and analysis (life cycle analysis can be after embodied energy); Case studies and analysis.

Self healing materials

Unit III: Recyclable And Renewable Materials

12 Hours

Concept of Recyclable materials – Sustainable Building Materials – Life Cycle Design of Materials – Biodegradable & Non- Biodegradable Materials – Green rating and Building Materials – Concept of Resource reuse, Recycled content, regional materials, rapidly renewable materials – Fly ash bricks, Cement – Recycled Steel, Bamboo based products.

Uses of renewable resources

Unit IV: Sustainable Construction

12 Hours

Design issues relating to sustainable development including site and ecology, community and culture, health, materials, energy, and water- Domestic and Community buildings use self-help techniques of construction - adaptation, repair and management - portable architecture.

Environmental land use classification

Unit V: Energy Efficient Technologies

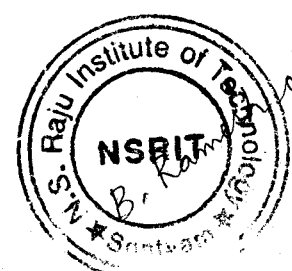
12 Hours

Energy Efficient Construction Technology – Filler Slab – Rat trap Bond –Traditional Building Construction Technologies – Introduction to other Technological interventions to save Energy – Intelligent Buildings – Energy Conservation through Technological intervention – Saving Energy used for lighting by design innovation – Case studies.

Renewable energy

Text Books

1. "Sustainable Building Design Manual – Volume II", Published by TERI, New Delhi, 2004
2. Jagadeesh, K. S., Venkata Rama Reddy, B. V. and Nanjunda Rao, K. S., "Alternative Building Materials and Technologies", New Age International Publishers
3. Kibert, C. J., "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2013



Reference Books

1. Steven V. Szokolay, "Introduction to Architectural Science – The Basis of Sustainable Design", Elsevier, 2007
2. Sandy Halliday, "Sustainable Construction", Routledge, Taylor & Francis Group, 2013
3. Dejan Mumovic and Mat Santamouris, "A Handbook of Sustainable Building Design and Engineering", Earthscan Publishing, 2009
4. Osman Attmann, "Green Architecture: Advanced Technologies and Materials", McGraw Hill, 2010

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2. <https://youtu.be/snYRU0QGxH0>
3. <https://www.slideshare.net/arundathipinky1/sustainable-architecture-55140947>
4. <https://www.slideshare.net/McNaughtonArchitecturalInc/green-building-sustainable-architecture-redlands-ca-mcnaughton-architectural-inc>

Internal Assessment Pattern

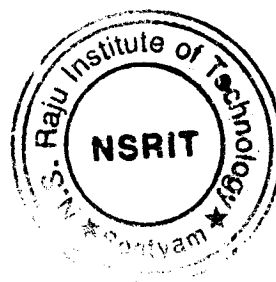
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What is Ecology?
 2. What do you mean green building
 3. What is meant by "LEED" building?
 4. Define sustainability

L2: Understand

1. Explain the dissertation ideas on sustainable construction
2. Discuss the construction resources for environmentally sustainable technologies
3. Discuss in detail the major objectives and fundamental principles in green building concept and describe any one GlobalGreen rating system



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PE 20CE012 Advanced Structural Analysis**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE002.1	Analyze Plane Trusses & Arches with the concept of Influence lines for forces	-	L3, L4
20CE002.2	Analyze cable and suspension bridges		L3, L4
20CE002.3	Application of matrix flexibility method		L3, L4
20CE002.4	Application of matrix stiffness Method		L3, L4
20CE002.5	Analyze structures using Kani's method, Plastic analysis and mechanism method		L3, L4
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Influence Lines for Forces in Plane Trusses and Arches**12 Hours**

N type truss - Pratt truss with parallel chords - Pratt truss with inclined chords - Warren truss with inclined chords. Symmetrical arches: Influence lines for horizontal thrust - Influence lines for B.M - Influence lines for S.F, B.M and normal thrust for moving concentrated loads and UDL - Muller Breslau principle

*Types of trusses***Unit II: Cables and Suspension Bridges****12 Hours**

Components and their Functions - Analysis of cable under concentrated loads and UDL - Shape of cable under self weight - Anchorage of suspension cables - Bending Moment and Shear Force in suspension bridges with three hinged stiffened girders - Max Bending Moment due to moving single concentrated load and UDL - Influence lines for Bending Moment and Shear Force - Analysis of suspension bridges with two hinged stiffening girders.

*Temperature stresses in the cable***Unit III: Matrix Flexibility Method****12 Hours**

Introduction - Computation of flexibility matrices - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.

*Flexibility Matrix***Unit IV: Matrix Stiffness Method****12 Hours**

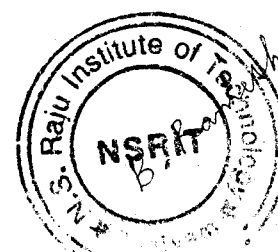
Introduction - equilibrium and compatibility - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of kinematic indeterminacy.

*Stiffness Matrix***Unit V: Miscellaneous****12 Hours**

Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy by Kani's method. Plastic analysis of structures - Assumptions - Moment redistribution - Analysis of fixed and continuous beams and portal frames by mechanism method.

*Kani's Method***Text Books**

1. Vazirani, V. N. and Ratwani, M. M., "Analysis of structures", Volume I & II, 4th Edition, Khanna publications, 2009
2. Pandit, G. S. and Gupta, S. P., "Matrix Methods of Structural Analysis", 2nd Edition, Tata McGraw Hill, 2000



Reference Books

1. Prakash Rao D. S., "Structural Analysis", 3rd Edition, Sagar Books, 2008
2. BhaviKatti S. S., "Structural Analysis", Volume I & II, 4th Edition, Vikas Publications, 2010
3. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House Pvt. Ltd., 2012

Web References

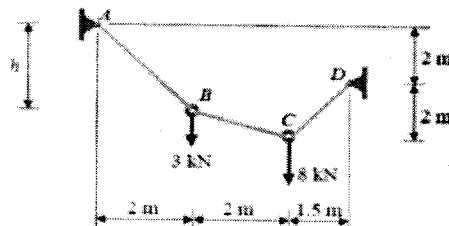
1. <https://nptel.ac.in/courses/105/106/105106050/>
2. <https://www.youtube.com/watch?v=s4CN6aVKhPo&list=PLEE5D02698EAAF2C0>

Internal Assessment Pattern

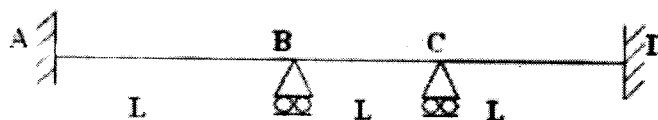
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L3	50	50
L4	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L3: Apply**

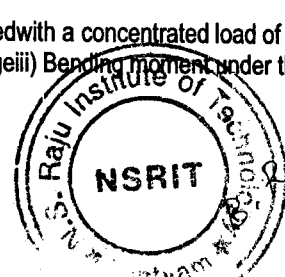
1. Distinguish between Flexibility method and Stiffness method
2. A three hinged parabolic arch hinged at the crown and springing has a horizontal span of 12 m and a central rise of 2.5 m. it carries a udl of 30 kN/m run over the left hand half of the span. Calculate the resultant at the end hinges
3. Explain the matrix approach to structural analysis of continuous beams
4. A simply supported beam has a span of 10 m. A uniformly distributed live load of 10 kN/m 6 m long moves on the girder from left to right. Find the shear force and bending moment at the mid section by influence line diagrams, when the head of the load is 1 m from the right end
5. Determine the tension in each segment of the cable shown in the figure below. Also, what is the dimension h?

**L4: Analyze**

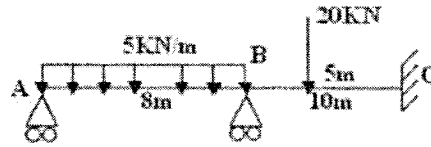
1. A three - hinged parabolic arch has a span of 40 m and rise of 8 m. Draw the influence lines for the following
 - i. Horizontal thrust
 - ii. Bending moment at a section 15 m from the left end
 - iii. Normal thrust at the above section
 - iv. Radial shear at the above section
2. Using the displacement method, analyse the continuous beam shown in figure, if spans AB & BC carry a u.d.l. of p/unit length. Hence calculate bending moments at B & C. EI is constant



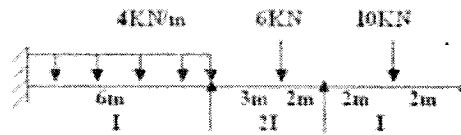
3. A 3-hinged arch is circular, 25 m in span with a central rise of 5m. It is loaded with a concentrated load of 10 kN at 7.5 m from the left hand hinge. Find the i) Horizontal thrust ii) Reaction at each end hinge iii) Bending moment under the load



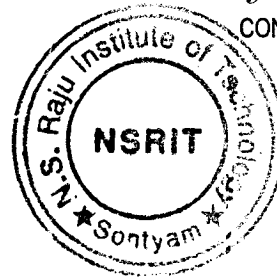
4. Using the force method, analyse the continuous beam shown in figure, treating the bending moments at B & C as redundants. Hence calculate support reactions. EI is constant



5. Analyse the Continuous beam shown in figure using Kani's method



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OE 20CE001 Urban Environment and Health

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE001.1	Identify urban – health relationships		L1, L2
20CE001.2	Demonstrates the connection between urban built form and health outcomes		L1, L2
20CE001.3	Discuss the distribution of health risks of urban transportation grid		L1, L2
20CE001.4	Assess and plan for community needs in health-care infrastructure		L1, L2
20CE001.5	Identify preliminary opportunities for advancing urban health outcomes		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Health and Planning

9 Hours

Introduction: The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form, Physical Activity.

Health Promotion

Unit II: Built Urban Form and Health

9 Hours

Renewing the Health-Urban Link, the Urban Form, the Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

Alternatives to Metropolitan Sprawl Index

Unit III: Transportation Systems

9 Hours

Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrians Travel, Proximity and Individual Factors.

Residential and Travel Preferences

Unit IV: Spatial Access to Health Services

9 Hours

Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behavior, Access and Mortality.

Access to health care Aligned with Transport

Unit V: Challenges and Opportunities

9 Hours

Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

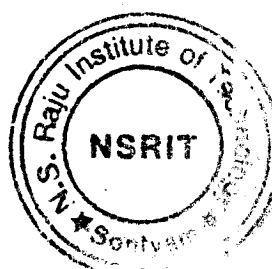
Promotion of physical activity in daily routines

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, "Global Climate Change and Human Health", 1st Edition Jossey-Bass, 2015

Reference Books

1. Pataki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions" *Frontiers in Ecology and the Environment*, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Island Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014



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Web References

1. <https://www.oecd.org/health/health-systems/32006565.pdf>
2. <https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

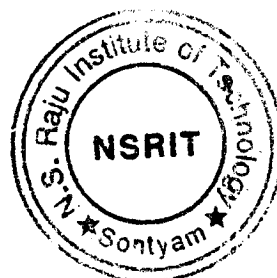
- L1: Remember**
1. How is natural environment different from urban environment?
 2. How does the urban environment affect health and well-being?
 3. How can urban areas improve health?

L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The study authors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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OE 20CSO01 Data Structures and Algorithms

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CSO01.1	Understand the advanced data structures and algorithms	-	L1, L2, L3
20CSO01.2	Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures.	-	L1, L2, L3
20CSO01.3	Demonstrate through various searching & sorting techniques	-	L1, L2, L3
20CSO01.4	Apply data structures and algorithms to solve real world problems.	-	L1, L2, L3
20CSO01.5	Apply algorithm analysis techniques to evaluate the performance of an algorithm.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Structures & Algorithms

9 hours

Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions. Algorithm Specifications: Performance Analysis and Measurement

Efficiency of an Algorithm

Unit II: Arrays and Linked Lists

9 hours

Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations. Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List. Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

Generalized Linked List, Applications of Stack and Queue

9 hours

Unit III: Trees and Graphs

Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

Applications of Tress and Graph

Unit IV: Algorithm Design Techniques I

9 hours

Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques.

Preferences of Merge and quick sort techniques.

Unit V: Algorithm Design Techniques II

9 hours

Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Usages of Greedy algorithms.

Text Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2. Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3. Mark Allen Weis, "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

Reference Books

1. Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2. Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3. Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009



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Web References

1. <https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/>
2. <https://www.geeksforgeeks.org/data-structures/>
3. <https://www.programiz.com/dsa>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures

L2: Understand

1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

L3: Apply

1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion



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OE 20AIO01 Machine Learning for Engineers

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO01.1	Describe different types of learning's	-	L1, L2
20AIO01.2	Explain different supervised learning algorithms		L1, L2
20AIO01.3	Explain different unsupervised learning algorithms		L1, L2
20AIO01.4	Describe various types of machine learning models		L1, L2
20AIO01.5	Choose appropriate machine learning model and algorithm for given task		L1, L2
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to learning

9 hours

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

Examples of regression

Unit II: Linear Models

9 hours

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Applications of perceptron

Unit III: Trees and Probabilistic Models

9 hours

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

Self-Organizing Feature Map

Unit IV: Dimensionality Reduction and Evolutionary Models

9 hours

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Geneticalgorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

Markov decision process

Unit V: Graphical Models

9 hours

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

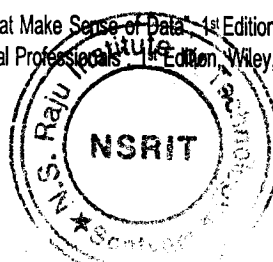
Tracking Methods

Text Books

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

Reference Books

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014



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3. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

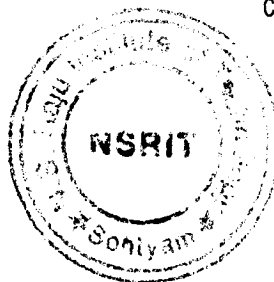
L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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20DSO01 Introduction to Database Management Systems**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos	DoK
20DSO01.1	Describe the basic concepts of DBMS And different data models	-	L1,L2
20DSO01.2	Apply Constrains on relations		L2,L2,L3
20DSO01.3	Apply SQL commands on relations		L1,L3
20DSO01.4	Understand PL/SQL operations		L1,L2,L3
20DSO01.5	Understand the principles of database normalization and Transaction management system.		L1,L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create DoK: Depth of Knowledge			

Unit I: Introduction to Databases**9 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

*History of DBMS***Unit II: Relational Model, Relational Algebra and Relational calculus****9 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins, Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

*Expressive Power of Algebra and Calculus***Unit III: Structured Query Language****9 Hours**

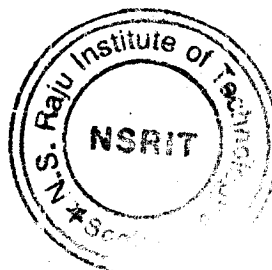
SQL: Concept of different Database Languages over SQL - DDL, DML, DCL., Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

*Compare all Database Languages***Unit IV: Schema Refinement and Normalization****9 Hours**

Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors, Stored procedures packages

*Compare all Normal Forms***Unit V: Normalization****9 Hours**

Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition, 4NF and 5N. Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

Concurrency Control without Locking*B. Ramesh chandra*

Text Books

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date C.J, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition, Pearson Education, 2013

Web References

1. <https://www.javatpoint.com/dbms-tutorial>
2. <https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:
(1) Order by (2) group by and having (3) as select (4) schema
4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properties

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A → B, BC → E, and ED → A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:
Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializability concept

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OE 20ECO01 Architectures and Algorithms of IoT

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO01.1	Demonstrate the Architecture and applications of IoT		L1, L2
20ECO01.2	Explain the protocol concept and data bases of IoT		L1, L2, L3
20ECO01.3	Construct the IoT device design space and Platform design		L1, L2, L3
20ECO01.4	Explain the IoT network model and Event analysis		L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Things and its Architecture		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: The IoT Landscape

09 Hours

What Is IoT?, Applications, Architectures, Wireless Networks, Devices, Security and Privacy, Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures

09 Hours

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetry Transport (MQTT)

Unit III: IoT Devices

09 Hours

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption.

Platform Design

Unit IV: Event-Driven System Analysis

09 Hours

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things

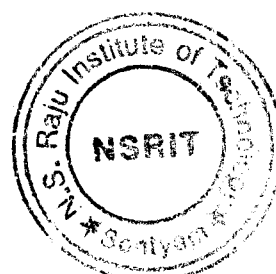
09 Hours

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

Integrated IIoT

Textbooks

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, Cham, 2018
2. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", Universities Press, 2015



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Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

Web Resources

1. <https://books.google.co.in/books?isbn=1119969093>
2. <https://books.google.co.in/books?isbn=135123093X>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

L2: Understand

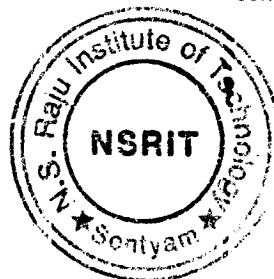
1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Data bases of IoT
5. Demonstrate the IoT Device Design Space

L3: Apply

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT

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Chairman
Board of Studies (ECE)

OE 20EE001 Introduction to Renewable Energy Sources

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE001.1	Understand the significance of solar energy		L1, L2
20EE001.2	Provide the importance of Wind Energy		L1, L2
20EE001.3	Understand the role of ocean energy in the Energy Generation		L1, L2
20EE001.4	Explain the utilization of Biogas plants and geothermal energy		L1, L2
20EE001.5	Explain the concept of energy Conservation		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create, DoK:Depth of Knowledge			

Unit I: Solar Energy

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar, Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

09 Hours

Thermal analysis of flat plate collectors

Unit II: Wind Energy

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

09 Hours

Betz Criteria

Unit III: Ocean Energy

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

09 Hours

Open and closed OTEC Cycle

Unit IV: Bio Mass

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

09 Hours

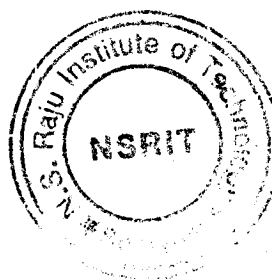
I.C Engine Operation

Unit V: Geo Thermal Energy and Energy Conservation

Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

09 Hours

Hydro Thermal, Geo-pressured, Hot dry rocks



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Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd., 2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley, 2013
3. Ranjan Rakesh, Kothari D. P. & Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor & Francis, 2006

Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill, 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2nd Edition, Tata Mcgraw Hill, 2001

Web References

1. <https://nptel.ac.in/courses/121/106/121106014/>
2. <https://www.edx.org/learn/renewable-energy>
3. <https://www.coursera.org/learn/renewable-energy-resources-and-technologies>

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	30
L2	60	70
Total (%)	100	100

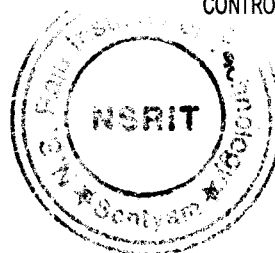
Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H₂ - O₂ fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.

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Chairman
Board of Studies (EEE)

OE 20MEO01 Nano Technology

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20MEO01.1	Describe the fundamental science of nano materials	-	L2
20MEO01.2	Demonstrate the preparation of nano materials		L1,L2
20MEO01.3	Explain of the challenges on safe nano technology		L1,L2
20MEO01.4	Develop knowledge in characteristic nano material		L1,L2,L3
20MEO01.5	Apply Nano science for industrial applications		L1,L2,L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

09 Hours

Introduction to properties and motivation for study (qualitative only)

Unit II: General Methods Of Preparation

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation.

09 Hours

Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

Unit III: Nano materials

Nanofoms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO₂, MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays- functionalization and applications-Quantum wires.

09 Hours

Quantum dots-preparation, properties and applications

Unit IV: Characterization Techniques

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

09 Hours

SIMS-Nano-indentation

Unit V: Applications

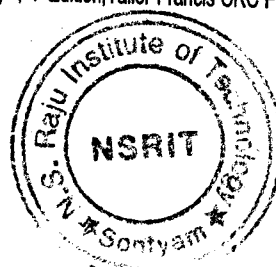
NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

09 Hours

Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TEXT BOOKS:

1. Edelstein A.S and Cammearata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute Of Physics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley- VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology" , 1st Edition, Springer Publications, 2013
4. Louis Homyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology" , 1st Edition, Tailor Francis CRC Press, 2008



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REFERENCE BOOKS:

1. Timp G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Web references:

1. <http://www.nano.gov>
2. <http://mrsec.wisc.edu/edetc/IPSE/links.html>
3. <http://nptel.ac.in/courses/112105182/9>
4. IOPSCIENCE—Nanotechnology

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	20
L2	60	40
L3		40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. What is Nano technology?
2. How does Nano Technology Works?
3. What are Nano Materials?
4. Who is Developing Nano technology?

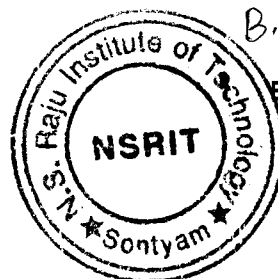
L 2: Understand

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?
2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?
3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?
4. What Is The Risk Of Not Developing Nanotech (In Health Care, Environmental Protection, And Economic Development)?

L 3: Applying

1. How are safety tests carried out in nano tech?
2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?
3. Discuss about targeted drug delivery using nanoparticles.

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Chairman
Board of Studies (ME)

OE 20CE002 Ecology, Environment and Resource Management

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CE002.1	Discuss the role that humans play in affecting the characteristics of the environment		L1, L2
20CE002.2	Understand the interrelationships between land, sea, the atmosphere and the living things that occupy these environments		L1, L2
20CE002.3	Distinguish between economic growth and economic development and outline the nature of a sustainable economy		L1, L2
20CE002.4	Identify the environmental attributes to be considered for the EIA study		L1, L2
20CE002.5	Develop a thorough understanding of Environmental Policies and legislations practiced in India		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction

9 Hours

Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structure and Function, Flow of material, Ecological Succession, Trophic levels, Food chain, Food web, Ecological pyramids.

Adaptation, Environmental Zones

Unit II: Ecosystem and its relevance to Environment

9 Hours

Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance. Settlement planning.

Energy Conservation

Unit III: Resource Management and Sustainable Development

9 Hours

Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

Planning for environmentally sensitive areas

Unit IV: Environmental Impact Assessment

9 Hours

Meaning, Significance and framework. Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources and acquisition of environmental information. Environment impact studies of development projects.

EIA Case Studies

Unit V: Environmental Policies and Legislations in India

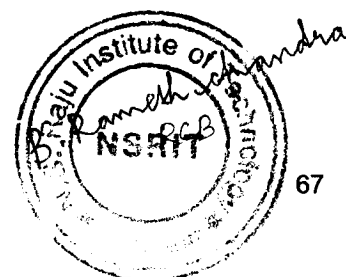
9 Hours

Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India - Environment Protection Act, 1986, National Conservation Strategy and Policy Statement on Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

Five year plans in relation to environmental aspects

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Waller E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007



Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van Nostrand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

Web References

1. http://iced.cag.gov.in/?page_id=256
2. <http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf>
3. https://www.researchgate.net/publication/341521590_Chapter_5_Environmental_Policy_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What is Ecology?
 2. List any three ways in which humans directly influence environmental conditions
 3. What is the goal of sustainable development?
 4. List the three sequential phases of EIA
 5. Enlist any four principles of National Environmental Policy of India

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy

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Board of Studies

OE 20CS002 Designing the Internet of Things**3 0 0 3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS002.1	Illustrate the IoT in different contexts	-	L1, L2
20CS002.2	Outline the Design Principles for Connected Devices		L1, L2
20CS002.3	Explain the Internet Principles & Application Layer Protocols		L1, L2
20CS002.4	Apply the Prototyping concepts in IoT		L1, L2
20CS002.5	Analyse the Prototyping Embedded Devices		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Overview of Internet of Things**9 hours**

The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

*Applications of IoT***Unit II: : Design Principles for Connected Devices****9 hours**

Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

*Examples of Connected Devices***Unit III: : Internet Principles****9 hours**

Internet Communications-IP, TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPV6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

*HTTPS: Encrypted HTTP***Unit IV: Thinking About Prototyping****9 hours**

Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

*Embedded Platforms***Unit V: Prototyping Embedded Devices****9 hours**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

*Ardino Components***Textbooks**

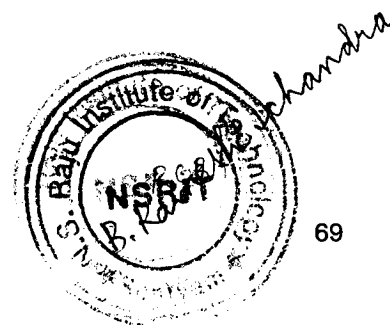
1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann, 2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

Web Resources

1. <https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/>
2. <https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything>
3. <https://www.javatpoint.com/iot-internet-of-things>



Internal Assessment Pattern

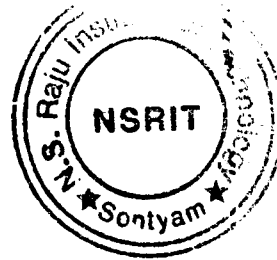
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

L1: Remembering

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understanding

1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping



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Board of Studies (CSE)

OE 20AIO02 Fundamentals of Deep Learning

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO02.1	Describe the fundamental concept of artificial neural networks	-	L1, L2
20AIO02.2	Describe the function of different deep neural networks		L1, L2
20AIO02.3	Explain different deep learning algorithms		L1, L2
20AIO02.4	Describe the functioning of convolution and recurrent neural networks		L1, L2
20AIO02.5	Choose appropriate deep neural network for given application		L1, L2
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit 1: Introduction to Deep Learning

Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Logic gates with perceptron

9 hours

Unit 2: Feedforward Networks

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

Applications of multilayer perceptron

9 hours

Unit 3: Convolution Networks

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Applications of CNN

9 hours

Unit 4: Recurrent Neural Networks

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

Applications of RNN

9 hours

Unit 5: Applications of Deep Neural Networks

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

Healthcare applications

9 hours

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras", Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books

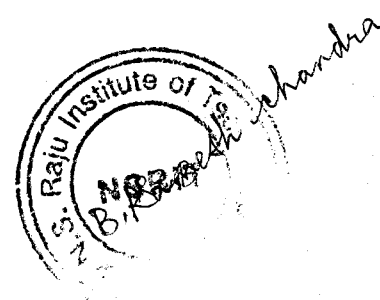
1. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References

1. <https://www.coursera.org/specializations/deep-learning>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100



Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

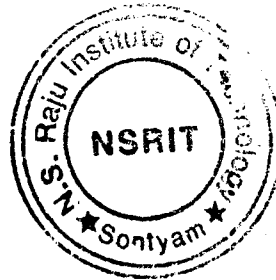
L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks

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OE 20DSO02 Introduction to Data Science

At the end of the course, students will be able to

At the end of the course, students will be able to:		Mapping with POs	DoK
Code	Course Outcomes	-	L1, L2
20DSO02.1	Understand Fundamentals of Data Science Terminology.		L1, L2
20DSO02.2	Demonstrate different computing tools involved in data handling.		L1, L2
20DSO02.3	Understand Knime Tool.		L1, L2
20DSO02.4	Understand Machine Learning Concepts		L1, L2
20DSO02.5	Apply domain expertise to solve real world problems using data science		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

9 Hours**Unit I: Introduction to Data Science**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three Vs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

Identifying Data Science Users; Data Engineering in Action: A Case Study

9 Hours**Unit II: Computing for Data Science - 1**

Using Python for Data Science, Using Open Source R for Data Science.

Sorting Out the Python Data Types; R's Basic Vocabulary

9 Hours**Unit III: Computing for Data Science - 2**

Using SQL in Data Science, Doing Data Science with Excel and Knime

Basic SQL Commands; Knime Basics

9 Hours**Unit IV Machine Learning, Probability and Statistical Modelling**

Defining Machine Learning and Its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistics, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

Linear Regression

9 Hours**Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science**

Data Science in Journalism, Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growth

Text Books

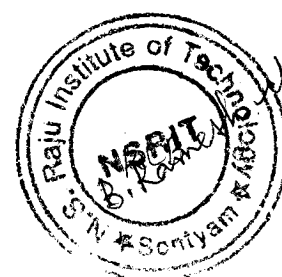
1. Lillian Pierson and Jake Porway, "Data Science For Dummies", 2nd Edition, For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

Web Resources

1. <https://www.simplilearn.com/tutorials/data-science-tutorial/>
2. <https://www.w3schools.com/datascience/>



Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50

Sample Short and Long Answer Questions of Various Cognitive Levels

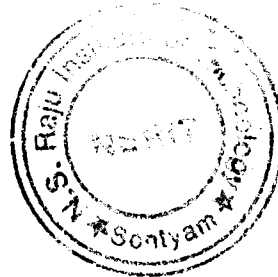
- L1: Remember**
1. What is data science? Identify three areas or domains in which data science is being used
 2. Give three examples of structured data formats
 3. Name three measures of centrality and describe how they differ
 4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?

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Board of Studies (CSE)**

OE 20ECO02 IoT for Smart Grids

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO02.1	Demonstrate the Smart Grid concept ,Need for smart grid	-	L1, L2
20ECO02.2	Explain the Energy Management system functions		L1, L2, L3
20ECO02.3	Describe how modern power distribution system functions		L1, L2
20ECO02.4	Explain the Advanced metering infrastructureand AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks forSmart Grid applications		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

09 Hours

Unit I: Introduction to Smart Grid

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

Technology Drivers

09 Hours

Unit II: Energy Management System

Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

Energy Storage

09 Hours

Unit III: Distribution Management System

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Network Reconfiguration

09 Hours

Unit IV: Smart Meters

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

Peak Time Pricing

09 Hours

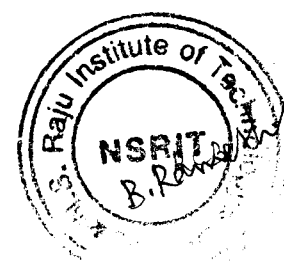
Unit V: Communication Networks & IoT

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

Cyber Security for Smart Grid

Textbooks

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid:Technology and Applications", Wiley, 2012



Reference Books

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

Web Resources

1. <https://books.google.co.in/books?isbn=1119969093>
2. <https://books.google.co.in/books?isbn=135123093X>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

L2: Understand

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

L3: Apply

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain

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3 0 0 3

OE 20EEO02 Electrical Safety and Management

At the end of the course, students will be able to

At the end of the course, students will be able to:			
Code	Course Outcomes	Mapping with PO's	DoK
20EEO02.1	Understand the Indian electricity rules and their significance	-	L1, L2
20EEO02.2	Explain the safety standard in residential, commercial, and agricultural		L1, L2
20EEO02.3	Learn about electrical safety installation, testing and commission		L1, L2
20EEO02.4	Understand about electrical safety in distribution system		L1, L2
20EEO02.5	Explain flash-overs and corona discharge		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Indian Electricity Regulations and Acts and their Significance

09 Hours

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

The Electricity Act 2003 (Part 1,2,3,4 & 5) and Control Authority Safety Regulations

Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations

09 Hours

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

System grounding and Equipment grounding

Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance

09 Hours

Preliminary preparations – safe sequence – risk of plant and equipment – safety documentation – field quality and safety – personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

Magnetic Hot sticks, protective clothing and industrial clothing

Unit IV: Electrical Safety in Hazardous Areas

09 Hours

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

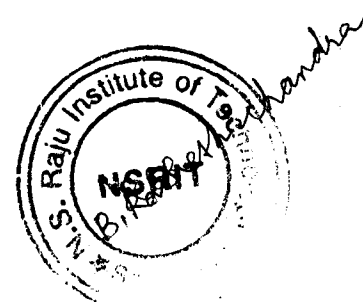
Hazards associated with currents and voltages

Unit V: Electrical Safety Shocks and their Prevention

09 Hours

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Objectives of Safety and Security Measures



Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

Web References

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/>
3. <https://www.edx.org/course/electricity-and-magnetism-maxwells-equations>

Internal Assessment Pattern

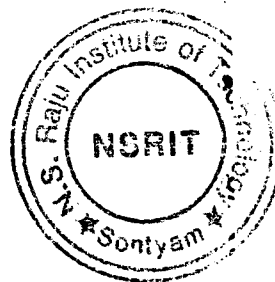
Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	40
L2	70	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. Give the classification of electrical installations.
 2. State the disadvantages of low power factor.
 3. What is safety documentation system?
 4. State preliminary preparations before commencing the installation.

L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.



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OE 20ME002 Fundamentals of Automobile Engineering

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tires and safety.	-	L1, L2
20ME302.2	Classify and identify the steering system		L2, L3
20ME302.3	Classify and identify the Transmission system		L2, L3
20ME302.4	Define and compare the suspension, breaking and electrical system.		L2, L4
20ME302.5	Identify and Interpret the specifications and safety precautions..		L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

09 Hours

Unit I: Introduction

Components of four wheel automobile – chassis and body – power unit – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation –. Types – wheels and tyres. Safety Introduction, safety systems – seat belt, airbags, bumper, anti lock brake system (ABS), windshield, suspension sensors, traction control, mirrors, central locking and electric.

windows, speed control.

09 Hours

Unit II: TRANSMISSION SYSTEM

Power transmission – rear wheel drive, front wheel drive, 4 wheel drive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive.

Torque tube drive, universal joint, differential rear axles.

09 Hours

Unit III: STEERING SYSTEM

Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears, – types *steering linkages.*

09 Hours

Unit IV: SUSPENSION, BRAKING AND ELECTRICAL SYSTEM

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism, solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

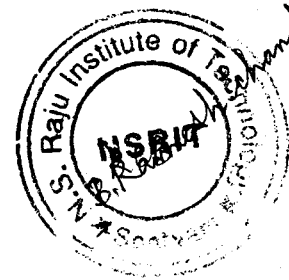
pneumatic and vacuum brakes.

09 Hours

Unit V: ENGINE SPECIFICATION AND MAINTENANCE

Introduction – engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling etc. engine service, re boring, decarburization, Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston – connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly – precautions. Types of pollutants, mechanism of formation, concentration measurement, methods of controlling – engine modification, exhaust gas treatment – thermal and catalytic converters – use of alternative fuels for emission control

National and International pollution standards.



Text Books

1. Automotive Mechanics—Vol.1&Vol.2/Kirpal Singh/standard publishers
2. Automobile Engineering/William Crouse/TMH Distributors
3. Automobile Engineering/P. S Gill/S.K. Kataria & Sons/New Delhi.
4. Automobile Engineering/C Srinivasan/McGraw Hill

Reference Books

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr./Pearson Education Inc.
2. Automotive Engineering/K Newton, W. Steeds & T K Garrett/SAE
3. Automotive Mechanics: Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold

Web References

1. <https://nptel.ac.in/noc>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L2	40	30
L3	40	30
L4	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What are the differences between two and four stroke engines.
 2. Define the Octane number & Cetane number
 3. Explain the significance of governor in automobiles?
 4. What is an automotive differential and how does it work?
 5. Why are car steering wheels round?
 6. Why entropy decreases with the increase in temperature?

L2: Understand

1. Describe the Atkinson cycle.
2. Explain the flywheel with neat sketch.
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
6. What is 3-way converter?

L3: Classify

1. Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

L4: Interpret

1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second.
2. Name the car with engine having 4-valves and 5- valves per cylinder. gas at a pressure of 1.5Mpa, the gas expands according to the process. Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston



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HO 20CEH01 Cognitive Management of IoT for Smart Cities

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At the end of the course, students will be able to

Code	Course Outcomes
20CEH01.1	Understand the system of smart materials implemented in structures
20CEH01.2	Understand the techniques and its implementation.
20CEH01.3	Understand the concepts of Internet of Things and to Know basic communication protocols in IoT
20CEH01.4	Develop planning, scheduling of development activities.
20CEH01.5	Develop work break down structure, scheduling and project management of smart cities

Unit I: Introduction to Smart Materials

9 Hours

Introduction to Smart Materials– Instrumented structures functions and response –Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

Unit II: Actuators

9 Hours

Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magnetostructure Material – Shape Memory Alloys – Electro rheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials..

Unit III: Internet of Things

9 Hours

Introduction: Internet of Things Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications.

Unit IV: Smart Cities Planning and Development

9 Hours

Understanding smart cities - Dimension of smart cities - Global Standards and performance benchmarks, Practice codes - Smart city planning and development - Financing smart cities development - Governance of smart cities

Unit V: Project management in Smart Cities

9 Hours

Phases, Stages of project and work break down Structure - Project organization structure, Planning, Scheduling and CPM - Project cost analysis, resource allocation & leveling, Line of balancing technique - Project monitoring and control, Project risk management.

Text Books

1. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996
2. Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0:0996025510, 13: 978-0996025515
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. ISBN : 9781439892992
4. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science

Reference Books

1. Neural Networks and Fuzzy Systems by Bart. Kosko, Prietence hall of India, 1994. 2. Artificial Neural Networks by Robert J. Schalkoff.

Web References

1. NPTEL :: Civil Engineering – Smart Materials and Smart Structures
2. Internet of Things (iitb.ac.in)
3. Smart Materials and Smart Structures (iitb.ac.in)



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HO 20CEH02 Energy Efficient Buildings

At the end of the course, students will be able to

Code	Course Outcomes
20CEH02.1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement.
20CEH02.2	Recognize objectives of green building and roads
20CEH02.3	Understand and know the utility of solar energy in buildings and know about Green composites in buildings
20CEH02.4	Understand the Urban environment and Green Buildings
20CEH02.5	Identify the Nanomaterials used in Green Building Systems

Unit I: Energy Sources

9 Hours

Introduction to nexus between Energy, Environment and Sustainable Development; Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes; photosynthesis; food chains, classification of energy sources, quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.

Unit II: Energy Efficient and Sustainable Development

9 Hours

The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development; global warming; greenhouse gas emissions, impacts, mitigation and adaptation ; future energy Systems- clean/green energy technologies; International agreements/conventions on energy and sustainability - United Nations Framework Convention on Climate Change (UNFCCC); sustainable development.

Unit III: Green Building and Roads

9 Hours

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings.

Unit IV: Waste Management

9 Hours

Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment. Green roads and its construction procedure.

Unit V: Green Nanotechnology

9 Hours

Introduction to nanomaterials: Nanoparticles preparation techniques, Nanomaterials for "Green" Systems: Green materials, including biomaterials, biopolymers, bioplastics, and composites Nanotech Materials for Truly Sustainable Construction: Windows, Skylights, and Lighting. Paints, Roofs, Walls, and Cooling.

Text Books

1. Umberto Desideri, Francesco Asdrubali, "Handbook of Energy Efficiency in Buildings - A Life Cycle Approach", 1st Edition, Elsevier B.V, 2018
2. José Manuel Andújar, Sergio Gómez Melgar, "Energy Efficiency in Buildings", MDPI, 2020

Reference Books

1. Ristinen, Robert A. Kraushaar, Jack, J. A Kraushaar, Jack, P. Ristinen, 2nd Edition, John Wiley, "Energy and the Environment", ISBN: 9780471172482, Wiley, New York, 2006
2. Robert Bent, "Energy: Science, Policy, and the Pursuit of Sustainability", ISBN13:9781559639118, ISBN10: 1559639113, Island Press, 2002
3. Jagadish K. S., Venkataramareddy B. U. and Nanjundarao K. S., "Alternative Building Materials and Technologies", New Age International, 2014

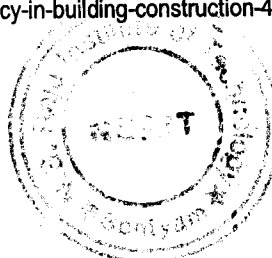
Web References

1. <https://nptel.ac.in/courses/105/102/105102175/>
2. <https://pdf4pro.com/view/lecture-notes-on-energy-efficiency-in-building-construction-4923d1.html>

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HO 20CEH03 Structural Health Monitoring

At the end of the course, students will be able to

Code	Course Outcomes
20CEH03.1	Diagnose the distress in the structure understanding the causes and factors
20CEH03.2	Assess the health of structure using static field methods
20CEH03.3	Assess the health of structure using dynamic field tests
20CEH03.4	Suggest repairs and rehabilitation measures of the structure
20CEH03.5	Formulate and analyse a case study of structural health monitoring

Unit I: Structural Health

9 Hours

Factors affecting Health of Structures, Causes of Distress, Regular Maintenance

Unit II: Structural Health Monitoring and Structural Audit

9 Hours

Concepts, Various Measures, Structural Safety in Alteration. Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

Unit III: Static Field Testing

9 Hours

Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

Unit IV: Dynamic Field Testing

9 Hours

Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

Unit V: Introduction to Repairs and Rehabilitations of Structures

9 Hours

Case Studies (Site Visits), piezo-electric materials and other smart materials, electro-mechanical impedance (EMI) technique, adaptations of EMI technique.

Text Books

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", Wiley - ISTE; 1st Edition, 2006

Reference Books

1. Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", John Wiley and Sons, 2006
2. Ou, J. P., Li, H., Duan, Z. D. and Taylor and Francis Group, "Structural Health Monitoring and Intelligent Infrastructure", Volume 1, London, UK, 2006
3. Victor Giurgutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc., 2007

Web References

1. <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-oe05/>
2. <https://www.youtube.com/watch?v=IHKoohRHRlI>
3. https://www.iitk.ac.in/ce/test/MoHUPA%20Presentation_Dr.K%20Roy%20_%20Dr.S.Mukhopadhyaya.pdf



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MI 20CEM01 Air Pollution

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping withPOs	DoK
20CEM01.1	Identify different types of pollution and their sources	-	L1,L2
20CEM01.2	Identify the meteorological components		L1,L2
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation		L1,L2
20CEM01.4	Explain various types of air pollution control equipment and their working principles		L1,L2
20CEM01.5	Understand sampling methods and monitoring of air pollution		L1,L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction

9 Hours

Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminants, Particulate, Gases and Vapors, Primary and secondary air pollutants

Unit II: Meteorology

9 Hours

General atmospheric circulation, Atmospheric stability, Effect of meteorology on Plume dispersion, Inversion, Wind profiles and stack plume patterns

Unit III: Effects of Air Pollution

9 Hours

Effects of air pollution on human beings, plants and animals and properties. Global effects-Green house effect, Ozone depletion, heat island, dust storms, Automobile pollution sources and control, Photochemical smog

Unit IV: Air Pollution Control

9 Hours

Particulate matter and gaseous pollutants - Settling chambers, Cyclone separators, Scrubbers, Filters & Electrostatic precipitator

Unit V: Air Quality Sampling and Monitoring

9 Hours

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants

Text Books

- Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, International Edition, 2017
- Rao M. N., Rao H. V. N., "Air Pollution", 1st Edition, Mc Graw Hill, 2004

Reference Books

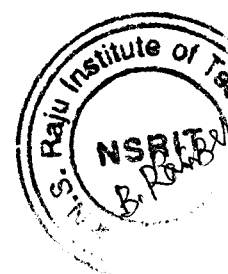
- Martin, Crawford, "Air Pollution Control Theory", Tata McGraw Hill, New Delhi, 1986
- Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013
- Rao C. S., "Environmental Pollution Control Engineering", Wiley Eastern Limited, New Delhi, 1992
- Gurjar, B. R., Molina, L., Ojha, C. S. P., "Air Pollution: Health and Environmental Impacts", CRC Press, 2010

Web References

- <http://www.epa.gov>
- <http://www.indiaenvironmentportal.org.in>
- <http://nptel.iitm.ac.in>
- <http://www.filtersource.com>
- <https://dgserver.dgsnd.gov>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100



Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Mention various sources of air pollution.
2. Define Atmospheric stability
3. Write a note on Ozone depletion
4. What are Filters & Electrostatic precipitators?

L2: Understand

1. What are Primary and secondary air pollutants?
2. Write the effect of effect of meteorology on Plume dispersion
3. Explain briefly about effects of air pollution on human beings, plants and animals and properties

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Board of Studies (CE)

MI 20CSM01 E-Commerce

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping withPOs	DoK
20CSM01.1	Explain the role of new internet economy in E-Commerce	-	L1,L2
20CSM01.2	Explain the architecture of World Wide Web		L1,L2
20CSM01.3	Describe the E-Commerce process models and E-Payment System		L1,L2
20CSM01.4	Illustrate the network models in customization and internal commerce		L1,L2
20CSM01.5	Explain the E-commerce models in advertising and marketing of business		L1,L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction

9 hours

Electronic Commerce- Architectural Frame work, anatomy of E-commerce applications, E-Commerce consumer applications, E-commerce organization applications

E-Commerce and media convergence

Unit II: World Wide Web & Network security

9 hours

Client-Server Network security, World Wide Web(WWW) as the architecture, Web background: Hypertext Publishing, Technology behind the web, Security and the web

Emerging Client-Server Security Threats

Unit III: E-Payment Systems

9 hours

Consumer Oriented Electronic Commerce- Mercantile Process models, E-Payment systems- Digital Token-Based, smart cards, credit cards, risk and E-Payment systems.

Designing E-Payment Systems

Unit IV: EDI Implementation and Intraorganizational E-Commerce

9 hours

Standardization and EDI, EDI Software implementation, Value added networks, Intra organizational E-Commerce- Workflow Automation and Coordination, Customization and Internal Commerce, Supply chain management (SCM).

EDI Envelope for Message Transport

Unit V: Advertising and Marketing on the Internet

9 hours

Corporate Digital Library- Document Library, digital document types, corporate data warehouses, Advertising and marketing-Information based marketing, Advertising on Internet, online marketing process, market research.

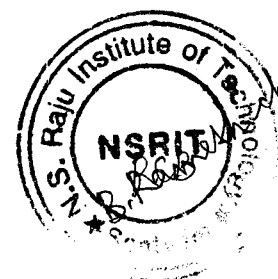
Charting the Online Marketing Process

Text Books

1. Ravi Kalakota and Andrew B. Whinston., "Frontiers of electronic commerce", First Edition, Pearson Education ,2011
2. Jaiswal S., "E-Commerce", Second Edition, Galgotia, 2010

Reference Books

1. Dave Chaffey., "E-business & E- commerce management- strategy, implementation and Practice", Fifth edition, Pearson Education, 2015.
2. Kenneth C, "E-Commerce: Business.Technology.Society", First Edition, Pearson Education, 2008



Web References

1. <https://www.techopedia.com/definition/18226/corporate-data-warehouse-cdw>
2. <http://ecmrce.blogspot.com>
3. <http://data.conferenceworld.in>

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

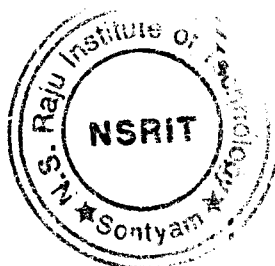
1. Write any four important E-Commerce organization Applications
2. Write about any four requirements of EDI
3. Write short notes on Risks in E-Payment systems
4. Write short notes on Market research
5. What are the factors for design of electronic payment system?

L2: Understand

1. How enterprise resource planning and supply chain management software differs in their goals and implementations
2. How product or service customization is adopted in intraorganizational commerce?
3. Explain Merchantile's model from the Merchant's perspective
4. Explain in detail about E-Payment systems
5. Discuss about mercantile transaction using credit cards

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MI 20MEM01 Biomaterials

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20MEM01.1	Classify various biomaterials	-	L1,L2
20MEM01.2	Identify the Metallic implant materials		L1,L2, L3
20MEM01.3	Describe the failure modes of implant materials		L1,L2
20MEM01.4	Apply Ceramic implant materials		L1,L2, L3
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials		L1,L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction**09 Hours**

Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra- vascular system). Surface properties of materials.

physical properties of materials, mechanical properties.

Unit II: Metallic implant materials**09 Hours**

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants.

Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit III: Polymeric implant materials**09 Hours**

Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers). Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems.

Synthetic polymeric membranes and their biological applications.

Unit IV: Ceramic implant materials**09 Hours**

Definition of bio ceramics. Common types of bio-ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).

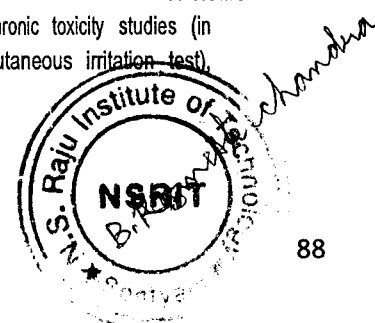
Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out).

Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit V: Biocompatibility & Toxicological screening of biomaterials**09 Hours**

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization.

carcinogenicity, mutagenicity and special tests.



Text Books

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4. Comprehensive structural integrity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.

Reference Text books

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/113104009.pdf
2. RBM603 BIOMATERIALS Syllabus free download
3. UP Technical University BE BM Syllabus
4. RBM603 Syllabus, BM Unit-wise Syllabus – BE 6th Semester

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	10	10
L2	30	30
L3	60	60
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Write about classification of biomaterials?
2. State the applications of biomaterials?
3. List the advantages and disadvantages biomaterials?
4. Write about Effects of physiological fluid on the properties of biomaterials?
5. Define Importance of stress-corrosion cracking?

L2: Understand

1. Surface properties of materials
2. Comparison of properties of some common biomaterials
3. Corrosion behavior and the importance of passive films for tissue adhesion
4. Visco elastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity

L3: Apply

1. Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions



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20EEM01 Basic Control Systems

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEM01.1	Determine time response specifications of second order systems		L1-L2
20EEM01.2	Determine error Constants for different types of input signals		L1-L2
20EEM01.3	Understand various levels of illuminosity produced by differentilluminating sources.		L1-L3
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.		L1-L3
20EEM01.5	Understand the speed/time characteristics of different types ofraction motors.		L1-L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create, DoK:Depth of Knowledge			

Unit I: Introduction to Control Systems

09 Hours

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems

Differences between Closed loop and Open Loop Control Systems

Unit II: Time Response Analysis

09 Hours

Standard test signals time response of first and second order systems time domain specifications, steady state errors and error constants

Definitions of Time domain Specifications

Unit III: Stability

09 Hours

The concept of stability, Routh's stability criteria – Limitations of Routh's stability, effect of addition of poles and zeros, introduction to root locus.

Basics of Routh's Criteria

Unit IV: Frequency response

09 Hours

Introduction to frequency domain specifications, basics of bode plot, Phase margin, Gain Margin. Introduction to Polar plots, its phase margin and gain margin. Introduction to Nyquist stability criteria

Definitions of Frequency domain Specifications

Unit V: State Space Analysis

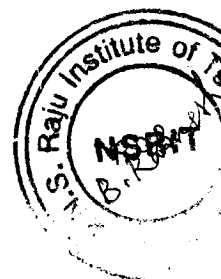
09 Hours

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Basics of Matrix operations

Text Books

1. I.J.Nagarath and M.Gopal, "Control Systems Engineering", Newage International Publications, 5th Edition, 2014.
2. Kotsuhiko Ogata, Modern Control Engineering, Prentice Hall of India, 5th edition, 2014



Reference Books

1. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 3rd Edition, 2012.

Web References

1. <https://nptel.ac.in/courses/107/106/107106081/>
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What are the various standard test signals?
 2. Define concept of observability.
 3. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Explain about feedback characteristics.
3. Describe the effect of addition of poles and zeros.

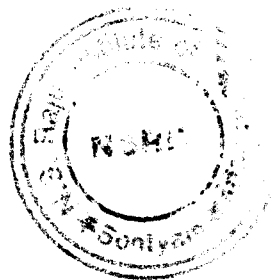
L3: Apply

1. The characteristic polynomial of a system is $s^5 + 2s^4 + 3s^3 + s^2 + 5s + 7 = 0$. Determine the stability of the system using Routh's stability criteria.
2. Determine range of K for stability of unit feedback system whose open loop transfer function is $G(s) = K/s(s+1)(s+2)$.
3. For a system having $G(s) = 25/s(s+10)$ and units negative feedback, find its time response specifications.

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20ECM01 Semiconductor Devices and Circuits**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECM01.1	Classify different types of semiconductors with energy band diagrams		L1, L2
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes		L1, L2
20ECM01.3	Classify and Analyze different types of rectifiers		L1, L2, L3
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization		L1, L2, L3
20ECM01.5	Analyze and Design the small signal low frequency amplifiers		L1, L2, L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Semiconductor Physics**09 Hours**

Atomic structure, Neil Bohr's atomic theory, definition of conductors, insulators and semiconductors, energy level diagrams. Semiconductors: Classification and types, intrinsic and extrinsic, P-type and N-type semiconductors, majority and minority carriers, recombination, effect of temperature.

*Fermi Level, Charge Densities in Semiconductors***Unit II: Semiconductor Diodes and Special Diodes****09 Hours**

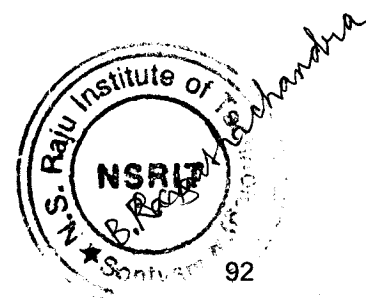
Formation of depletion region, barrier potential, reverse breakdowns, PN junction as diode, symbol, biasing modes, V-I characteristics, diode current equation, effect of temperature on diode current, ideal diode. Special Diodes: Zener diode, Photo Diode, LED - Working, characteristics and applications.

*Diode Switching times, Varactor diode, Tunnel Diode***Unit III: Rectifiers and Filters****09 Hours**Half wave Rectifier, Full wave rectifier, Bridge Rectifier - Operation, Input and output wave forms. Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.*LC filter, Multi section π filter***Unit IV: Transistors and Biasing Techniques****09 Hours**Junction transistor, Transistor current components, Transistor configurations, Transistor as an amplifier, characteristics of transistor in CB and CE configurations. Need for biasing, operating point, Load line analysis, fixed bias and self bias, Stabilization against variations in V_{BE} , I_C and β , Stability factor, Thermistor and Sensistor bias compensation techniques, Thermal runaway.*Ebers-Moll model of a transistor, Punch through/reach through, Thermal stability***Unit V: Small Signal Low Frequency Transistor Amplifier Models****09 Hours**

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB and CE amplifiers, Comparison of transistor amplifiers.

*Effects of emitter bypass capacitor (C_E) on low frequency response***Textbooks**

1. Lal Kishore K., "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016
2. Millman J. and Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2009
4. Boylestad R. L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009



Reference Books

1. Salivahanan S., Suresh Kumar and Vallavaraj N. A., "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010
3. Millman J. and Halkias C., "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. Singh B. P. and Rekha, "Electronic Devices and Integrated Circuits", 3rd Edition, Pearson publications, 2009
5. Mittal G. K., "Electronic Devices and Circuits", 3rd Edition, Khannan Publishers, 2008

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. <http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html>
3. <http://nptel.ac.in/courses/117103063/11>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

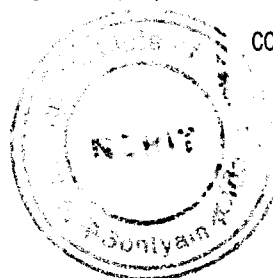
1. Define Semiconductor
2. What is ideal diode?
3. List any three applications of Zener diode
4. What is rectifier?
5. Define ripple factor
6. What is BJT?
7. What is thermal runaway?
8. Define stability

L2: Understand

1. Describe the formation of P type semiconductor
2. Draw and explain V-I characteristics of PN junction diode
3. Describe the construction and operation of Photo diode
4. With neat circuit diagram describe the operation of bridge rectifier
5. Explain, why Zener diode is used in reverse bias with the help of characteristics
6. Draw and explain the input and output Characteristics of Common base configuration
7. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
8. Write a short note on Thermal Runaway
9. Explain thermistor compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier



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20AIM01 Fundamentals of Neural Networks

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIM01.1	Describe the concepts of artificial neural networks	-	L1, L2
20AIM01.2	Compare functions of biological and artificial neural networks		L1, L2
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks		L1, L2
20AIM01.4	Describe architecture and functioning of Multi-layer networks		L1, L2
20AIM01.5	Explain associative memory networks		L1, L2
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit 1: Introduction to Neural Networks

9 hours

Introduction - Humans and Computers - Organization of the Brain – Biological Neuron - Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN

Unit 2: Essentials of ANN

9 hours

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules

Unit 3: Single Layer Feedforward Networks

9 hours

Introduction - Perceptron Models: Discrete - Continuous and Multi-Category - Training Algorithms: Discrete and Continuous Perceptron Networks – Limitations of the Perceptron Model

Unit 4: Multi - Layer Feedforward Networks

9 hours

Generalized Delta Rule - Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Kolmogorov Theorem, Learning Difficulties and Improvements

Unit 5: Associative Memory Networks

9 hours

Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Companies, 2006
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley Publishing Company

Reference Books

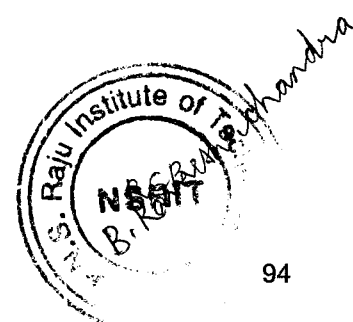
1. B. Yagna Narayana, "Artificial Neural Networks", Prentice Hall India, 2013
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education

Web Resources

1. https://www.tutorialspoint.com/artificial_neural_network/index.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100



Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

5. Define Neural Computing
6. Define ANN and Neural Computing
7. List any 4 design parameters in the design of Artificial Neural Network
8. What kinds of transfer functions can be used in each layer?
9. Define Pattern Association
10. What is Adaline Model?
11. What are the types of Learning?
12. What is simple artificial neuron?
13. List any 4 applications of Artificial Neural Network
14. Define Delta Learning rule

L2: Understand

4. Describe on the process of assigning and updating weights in a artificial neural network
5. What are the design steps to be followed for using ANN for your problem?
6. Describe least square algorithm with example
7. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
8. Explain Back Propagation Network with necessary diagrams and equations
9. Write the differences between Hetero Associative Memories and Interpolative Associative Memories

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20DSO03 Introduction to R Programming**3 0 0 3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20DSO03.1	Understand the basic concepts of R programming		L1, L2
20DSO03.2	Understand about Scalars and Vectors		L1, L2,
20DSO03.3	Implement Lists and data Frames		L1, L2, L3
20DSO03.4	Implement Tables and Statistical Distributions		L1, L2, L3
20DSO03.5	Implement Functions in R programming		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create DoK: Depth of Knowledge			

Unit I: Introduction**9 Hours**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

*Variable Scope & Default Arguments***Unit II: Control Structures And Vectors****9 Hours**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

*Higher-Dimensional Arrays***Unit III: Lists****9 Hours**

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

*Merging Data Frames***Unit IV: Factors and Tables****9 Hours**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

*Aaggregate () Function, Set Operations***Unit V: Functions****9 Hours**

Scripts to Functions, Making the Script, Transforming the Script, Using the Function, Reduce the number of Lines, Adding more Arguments, Dots, Using Functions as Arguments, Crossing the Borders, Choices with If-Else Statements, vectorizing Choices, Looping Through Values

Coping and Scoping of Functions

Text Books

1. Norman Matloff, "The Art of R Programming- A Tour of Statistical Software Design ", 2011
2. Roger D. Peng, "R Programming for Data Science ", 2012

Reference Books

1. Garrett Golemund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions and Simulations", 1st Edition, 2014
2. Andrie de Vries, Joris Meys, "R For Dummies", 2nd Edition, 2015

Web References

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. <https://data-flair.training/blogs/object-oriented-programming-in-r/>
3. <http://www.r-tutor.com/elementary-statistics>
4. <https://www.tutorialspoint.com/r/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

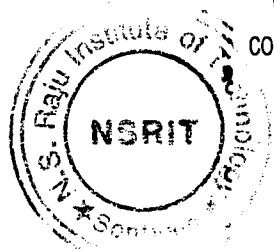
1. Write about vectors in R
2. Write any three type conversions in R
3. What is a data structure in R?
4. Write any two Boolean operators in R
5. Write any two linear vector algebra operations

L2: Understand

1. Explain the importance of data frame
2. How to apply same functions to all rows and columns of a matrix? Explain with example
3. Explain about Finding Stationary Distributions of Markov Chains
4. Describe R functions for Reading a Matrix or Data Frame from a File
5. Explain different matrix operation function in R

L3: Apply

1. Implement binary search tree with R
2. Write R script to create a line graph
3. Create a R language code to generate first n terms of a Fibonacci series
4. Apply R program to implement quicksort
5. Apply R code to the function by using if else command $f(x) = x$ if $x < 1/2$
 $= (1-x)$ if $1/2 \leq x < 1$
 $= 0$ otherwise

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