



# SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

[www.sathyabama.ac.in](http://www.sathyabama.ac.in)

School of Building and Environment

Department of Civil Engineering

## **BOARD OF STUDIES MEETING - Academic year 2019-2020**

The periodic Board of studies meeting, for the Department of Civil Engineering, School of Building and Environment (both UG and PG programme) will be held on 03.04.2019 at 10.00 AM.

### **Internal members**

1. Dr.Devyani Gangopadhyay, Dean, School of Building and Environment
2. Dr.S.Packialakshmi, Professor, Department of Civil Engineering
3. Dr.R.Padmapriya, Professor, Department of Civil Engineering
4. Dr.V.Sampathkumar, Professor, Department of Civil Engineering
5. Dr.S.Nandhakumar, Assistant Professor, Department of Civil Engineering

### **External members**

1. Dr.R.Santhakumar, Professor, Department of Civil Engineering, NITTTR, Chennai
2. Dr.R.Saravanan, Associate Professor, CWR, Anna University, Chennai

### **Agenda:**

- Review of Curriculum for the upcoming academic year for both B.E. Civil Engineering and programmes

**Convenor/Dean**

**HOD**

**Expert member**



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## *Minutes of Board of studies meeting*

The periodic Board of Studies Meeting for the Academic Year 2019-2020 (both UG and PG programme) is held on 3<sup>rd</sup> April, 2019 at 1.00 pm at VC Conference Hall, Administrative Block.

### **Members Present:**

1. Dr.R.Santhakumar, Professor, Department of Civil Engineering, NITTTR, Chennai
2. Dr.R.Saravanan, Associate Professor, CWR, Anna University, Chennai
3. Dr.Devyani Gangopadhyay, Dean, School of Building and Environment
4. Dr.S.Packialakshmi, Professor, Department of Civil Engineering
5. Dr.R.Padmapriya, Professor, Department of Civil Engineering
6. Dr.V.Sampathkumar, Professor, Department of Civil Engineering
7. Dr.S.Nandhakumar, Assistant Professor, Department of Civil Engineering

Dr. Devyani Gangopadhyay, Dean, School of Building and Environment has initiated the Board of Studies meeting for the B.E. Civil Engineering Program and Master of Engineering in Structural Engineering Program.

The discussion of the meeting by the board of studies members is highlighted as follows;

- As per the recommendations of AICTE, the credit points for the B.E. Civil Engineering program have been reduced from 190 to 164.
- Also, the total credits for the Program Master of Engineering in Structural Engineering have been reduced from 94 to 70.
- Industry 4.0 course can be added into B.E. Civil Engineering and M.E. Structural Engineering curriculum to learn the advancements in the industrial sectors.



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### Department of Civil Engineering

- Dr.R.Santhakumar, Professor, NITTTR, Chennai has suggested to add the topics RMC Specifications, Clay products - Refractory's - Composite materials - Types - Applications of laminar composites Fibre textiles - Geomembranes and Geo-textiles for earth reinforcement.
- Dr.R.Saravanan, Associate Professor, CWR, Anna University recommended to modify the title as Concrete and Construction Technology instead Construction Materials -II and add the contents such as types of Mortar, Timber products like plywood, fibre board, particle board, Reinforcing steel and its specifications, Glass, Plastics, A.C. Sheets, Bitumen, Adhesives, Aluminium and detailed topics in Cement such as Hydration of cement, Grading requirements of Aggregates, Quality of water for use in concrete.
- As per the discussion of Dr.V. Sampathkumar, Professor, Internal Board of Studies Member, the topics suggested for Highway Engineering Course are Sustainability and its importance in Highway Engineering, Considerations on Hill Roads, Hairpin Bends – Lateral and Vertical Clearance of Underpasses under Geometric Design Elements, Recycled Highway Construction materials - Quality Control Measures – Construction Machineries, Formulation of Highway Project report. Also, he suggested to remove the demonstration of MX – highway software as it involved only theoretical explanation.
- Dr.R.Santhakumar, Professor, NITTTR, Chennai has recommended the following contents in Surveying – II Course
  1. Aerial Photography-Aerial Survey - Terrestrial stereo photography - Aerial photography - Scale of vertical photography - Scale of vertical Tilted photograph - Photo interpretation – Parallax
  2. Remote Sensing and GIS - Remote sensing - basic procedure of setting out remote sensing - electromagnetic spectrum - energy interaction with earth surface - remote



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### Department of Civil Engineering

sensing in India - Global Information system - Hardware of GIS - Software of GIS -  
vector and raster data - Application of GIS - Remote sensing and GIS

3. Basic elements of total station - parts and accessories - errors - problems.

- Dr. S. Packialakshmi, Professor and Head has open up the suggestion to incorporate Inter Disciplinary Project for the program B.E. Civil Engineering in Semester 5 to encourage the students for doing collaborative project with other discipline of Engineering programmes.
- Dr.R.Saravanan, Associate Professor, CWR, Anna University has given option to add-on introduction to Flow-net and the simple problems involved under the chapter soil water and water flow.
- Keeping in view the development of Metro Railways in the Metropolitan cities of India, Dr.R.Santhakumar, Professor, NITTTR, Chennai recommended to incorporate the introduction of Railways in Metro cities in Railways, Airport and Harbour Engineering Course.
- Dr.R.Padmapriya, Professor has given suggestion for the inclusion of Torsion Test on Metal specimen by using Torsion Testing Machine to expose the students to test the materials on torsional force

Convenor/Dean

HOD

Expert member

**PROGRAMME: B.E.  
CIVIL ENGINEERING  
CURRICULUM**

<b>SEMESTER 1</b>										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SMTA1101	Engineering Mathematics - I	3	0	0	3	50	50	1
2.	Theory	SPHA1101	Physics for Engineers	3	1	0	4	50	50	2
3.	Theory	SBTA1101	Environmental Science and Engineering	2	0	0	0	-	-	4
4.	Theory	SCIA1101	Engineering Mechanics	3	*	0	3	50	50	5
5.	Theory	SCIA1102	Construction Materials	3	0	0	3	50	50	6
6.	Theory	SCIA1103	Engineering Graphics	3	*	0	3	50	50	7
7.	Practical	SPHA2101	Physics Lab	0	0	2	1	25	25	8
8.	Practical	SMEA2201	Workshop Practice	0	0	4	2	50	50	0
Total Credits for Semester 1 – 19										
Total Marks for Semester 1 - 650										

<b>SEMESTER 2</b>										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SHSA1101	Technical English	3	0	0	3	50	50	10
2.	Theory	SMTA1201	Engineering Mathematics - II	3	0	0	3	50	50	13
3.	Theory	SCYA1101	Engineering Chemistry	3	1	0	4	50	50	14
4.	Theory	SCSA1103	Programming in C	3	*	0	3	50	50	16
5.	Theory	SCIA1201	Concrete and Construction Technology	3	0	0	3	50	50	17
6.	Theory	SCIA1202	Functional Design of Buildings	3	0	0	3	50	50	18
7.	Practical	SCYA2101	Engineering Chemistry Lab	0	0	2	1	25	25	19
8.	Practical	SCSA2104	Programming in C Lab	0	0	4	2	50	50	20
9.	Practical	SCIA2201	Building Planning and Drawing lab	0	0	4	2	50	50	21
Total Credits for Semester 2 – 24										
Total Marks for Semester 2 – 850										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS,  
CAE – CONTINUOUS ASSESSMENT EXAMINATION,  
ESE – END SEMESTER EXAMINATION

SEMESTER 3										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SMTA1301	Engineering Mathematics – III	3	0	0	3	50	50	22
2.	Theory	SCIA1301	Mechanics of Solids – I	3	*	0	3	50	50	23
3.	Theory	SCIA1302	Mechanics of Fluids	3	*	0	3	50	50	24
4.	Theory	SCIA1303	Surveying - I	3	*	0	3	50	50	25
5.	Theory	SCIA1304	Highway Engineering	3	0	0	3	50	50	26
6.	Theory	SCIA1305	Engineering Geology	3	0	0	3	50	50	27
7.	Practical	SCIA2301	Surveying Lab - I	0	0	4	2	50	50	28
8.	Practical	SCIA2302	Strength of Materials Lab	0	0	4	2	50	50	29
Total Credits for Semester 3 – 22										
Total Marks for Semester 3 - 800										

SEMESTER 4										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SMTA1401	Engineering Mathematics - IV	3	0	0	3	50	50	30
2.	Theory	SCIA1401	Mechanics of Solids - II	3	*	0	3	50	50	31
3.	Theory	SCIA1402	Applied Hydraulic Engineering	3	*	0	3	50	50	32
4.	Theory	SCIA1403	Environmental Engineering - I	3	0	0	3	50	50	33
5.	Theory	SCIA1404	Surveying - II	3	*	0	3	50	50	34
6.	Theory	SAIC4001	Industry 4.0	2	0	2	2	50	50	35
7.	Practical	SCIA2401	Surveying Lab - II	0	0	4	2	50	50	36
8.	Practical	SCIA2402	Hydraulic Engineering Lab	0	0	4	2	50	50	37
Total Credits for Semester 4 – 21										
Total Marks for Semester 4 – 800										

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ESE – END SEMESTER EXAMINATION

SEMESTER 5										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SCIA1501	Structural Analysis - I	3	*	0	3	50	50	38
2.	Theory	SCIA1502	Reinforced Concrete Structures - I	3	*	0	3	50	50	39
3.	Theory	SCIA1503	Design of Steel Structures - I	3	*	0	3	50	50	40
4.	Theory	SCIA1504	Soil Mechanics	3	*	0	3	50	50	41
5.	Theory	SCIA1505	Environmental Engineering - II	3	0	0	3	50	50	43
6.	Theory	SCIA1506	Water Resources Engineering	3	0	0	3	50	50	44
7.	Practical	SCIA2501	Soil Mechanics Lab	0	0	4	2	50	50	45
8.	Practical	SCIA2502	Environmental Engineering Lab	0	0	4	2	50	50	46
9.	Practical	S20APT	Professional Training	0	0	4	2	50	50	-
Total Credits for Semester 5 – 24										
Total Marks for Semester 5 – 900										

SEMESTER 6										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SCIA1601	Structural Analysis - II	3	*	0	3	50	50	47
2.	Theory	SCIA1602	Reinforced Concrete Structures - II	3	*	0	3	50	50	48
3.	Theory	SCIA1603	Design of Steel Structures - II	3	*	0	3	50	50	49
4.	Theory	SCIA1604	Foundation Engineering	3	*	0	3	50	50	50
5.	Theory		Professional Elective - 1	3	0	0	3	50	50	-
6.	Practical	SCIA2601	Concrete Technology Lab	0	0	4	2	50	50	51
7.	Practical	SCIA2602	Highway Engineering Lab	0	0	4	2	50	50	52
8.	Project	S20AMPROJ	Interdisciplinary Project	0	0	6	3	50	50	-
Total Credits for Semester 6 - 22										
Total Marks for Semester 6 - 800										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS,  
 CAE – CONTINUOUS ASSESSMENT EXAMINATION,  
 ESE – END SEMESTER EXAMINATION

SEMESTER 7										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory	SBAA4002	Principles of Management and Professional Ethics	3	0	0	3	50	50	53
2.	Theory	SCIA1701	Railways, Airport and Harbour Engineering	3	0	0	3	50	50	54
3.	Theory	SCIA1702	Estimation, Costing and Valuation	3	*	0	3	50	50	55
4.	Theory	SCIA1703	Prestressed Concrete Structures	3	*	0	3	50	50	56
5.	Theory	SCIA1704	Construction Management	3	0	0	3	50	50	57
6.	Practical	SCIA2701	Computer Aided Analysis, Design of Structural Elements Lab	0	0	4	2	50	50	58
7.	Project	S20APROJ1	Project Work (Phase I)	0	0	6	3	50	50	-
Total Credits for Semester 7 - 20										
Total Marks for Semester 7 - 700										

SEMESTER 8										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1.	Theory		Professional Elective 2	3	0	0	3	50	50	-
2.	Theory		Professional Elective 3	3	0	0	3	50	50	-
3.	Project	S20APROJ2	Project Work (Phase – II)	0	0	14	7	50	50	-
Total Credits for Semester 8 - 13										
Total Marks for Semester 8 - 300										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS,  
 CAE – CONTINUOUS ASSESSMENT EXAMINATION,  
 ESE – END SEMESTER EXAMINATION



## LIST OF ELECTIVES

PROFESSIONAL ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1.	SCIA3001	Irrigation Engineering	3	0	0	3	50	50	59
2.	SCIA3002	Air and Noise Pollution	3	0	0	3	50	50	60
3.	SCIA3003	Ground Water Engineering	3	0	0	3	50	50	61
5.	SCIA3004	Solid Waste Management	3	0	0	3	50	50	62
6.	SCIA3005	Energy and Environmental Management	3	0	0	3	50	50	63
7.	SCIA3006	Finite Element Techniques	3	0	0	3	50	50	64
8.	SCIA3007	Mass transport Management	3	0	0	3	50	50	65
9.	SCIA3008	Traffic Engineering	3	0	0	3	50	50	66
10.	SCIA3009	Highway Pavement Design	3	0	0	3	50	50	67
11.	SCIA3010	Transport Economics	3	0	0	3	50	50	68
12.	SCIA3011	Design of Bridges	3	0	0	3	50	50	69
13.	SCIA3012	Advanced Structural Systems	3	0	0	3	50	50	70
14.	SCIA3013	Basics of Dynamics and Seismic Design	3	0	0	3	50	50	71
15.	SCIA3014	Procurement Engineering	3	0	0	3	50	50	72
16.	SCIA3015	Quality Control and Safety Management	3	0	0	3	50	50	73
17.	SCIA3016	Computer Applications in Civil Engineering	3	0	0	3	50	50	74
18.	SCIA3017	Smart Materials and Smart Structures	3	0	0	3	50	50	75
19.	SCIA3018	Basics of Remote Sensing and GIS	3	0	0	3	50	50	76
20.	SCIA3019	Tall Buildings	3	0	0	3	50	50	77
21.	SARA3020	Sustainable Architecture	3	0	0	3	50	50	78
22.	SARA3021	Steel in Architectural Design	3	0	0	3	50	50	79
23.	SARA3022	Environmental Planning and Design	3	0	0	3	50	50	80
24.	SARA3023	Building Automation System	3	0	0	3	50	50	81

OPEN ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SALA4001	Intellectual Property Law	3	0	0	3	50	50	A1
2	SAEA4001	Fundamentals of Aerospace Technology	3	0	0	3	50	50	A2
3	SBAA4001	Fundamentals of Management	3	0	0	3	50	50	A3
4	SBAA4002	Principles of Management and Professional Ethics	3	0	0	3	50	50	A4
5	SBTA4001	Biology for Engineers	3	0	0	3	50	50	A5
6	SBMA4001	Neurology	3	0	0	3	50	50	A6
7	SBMA4002	Modelling of Physiological Systems	3	0	0	3	50	50	A7
8	SBMA4003	Drug Delivery System	3	0	0	3	50	50	A8
9	SBMA4004	Fundamentals of Mechatronics	3	0	0	3	50	50	A9
10	SBMA4005	Virtuality and Augmented Reality	3	0	0	3	50	50	A10
11	SBMA4006	Medical Optics and Laser Applications	3	0	0	3	50	50	A11
12	SBMA4007	Forensic Science	3	0	0	3	50	50	A12
13	SBMA4008	Artificial Intelligence and Expert Systems	3	0	0	3	50	50	A13
14	SBMA4009	Human Factors in Engineering and Design	3	0	0	3	50	50	A14
15	SCHA4001	Corrosion Engineering	3	0	0	3	50	50	A15
16	SCHA4002	Energy Engineering	3	0	0	3	50	50	A16
17	SCHA4003	Environmental Impact Assessment	3	0	0	3	50	50	A17
18	SCHA4004	Environmental Pollution and Control	3	0	0	3	50	50	A18
19	SCIA4001	Disaster Management	3	0	0	3	50	50	A19
20	SCSA4001	R Programming	3	0	0	3	50	50	A20
21	SCSA4002	5 G Networks	3	0	0	3	50	50	A21
22	SECA4001	Software Tools for Engineering Applications	3	0	0	3	50	50	A22
23	SMEA4001	Resource Management Techniques	3	0	0	3	50	50	A23
24	SMEA4002	Wind and Solar Energy	3	0	0	3	50	50	A24

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CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION

Semester	Theory courses (including elective courses)			Practical Courses (including PT and project)		
	Total no.	Total Credits	Total Marks	Total no.	Total Credits	Total Marks
1	6	16	500	2	3	150
2	6	19	600	3	5	250
3	6	18	600	2	4	200
4	6	17	600	2	4	200
5	6	18	600	3	6	300
6	5	15	500	3	7	300
7	5	15	500	2	5	200
8	2	6	200	1	7	100
<b>Overall Total</b>	42	124	4100	18	41	1700

Overall total credits for B.E Civil Engineering	165
Overall total marks for B.E Civil Engineering	5800

SCIA1102	CONSTRUCTION MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To introduce the basic materials used in civil engineering construction field.

**UNIT 1 BUILDING MATERIALS****9 Hrs.**

Soil - classification of soil – Stone - Tests on stones - Deterioration and Preservation of stone work - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive Strength - Water Absorption - Efflorescence - Bricks for special use - Refractory bricks - Fly Ash Bricks and Concrete blocks - Light weight blocks and panels.

**UNIT 2 LIME CEMENT AGGREGATES MORTAR STEEL****9 Hrs.**

Lime - Preparation of lime mortar - Cement - Ingredients - Manufacturing process - Types and Grades - Properties of cement and Cement mortar - Hydration - Compressive strength - Tensile strength - Fineness - Soundness and consistency - Setting time - Aggregates - Natural stone aggregates - Crushing strength - Impact strength - Flakiness Index - Elongation Index - Abrasion Resistance - Mortar - classifications - properties of good mortar - uses of mortar - Manufacture of steel - properties and uses of different types of steel - mechanical and heat treatment of steel - Anticorrosive measures for steel.

**UNIT 3 CONCRETE****9 Hrs.**

Constituents of concrete (Cement and aggregate): Proportioning of concrete, water-cement ratio, Fresh concrete, Batching, Mixing, Transportation and placing, Compaction, Curing and finishes - Admixtures (Chemical, mineral) – **RMC specifications.**

**UNIT 4 TIMBER AND MODERN MATERIALS****9 Hrs.**

Timber - Market forms - Industrial timber - Doors and Windows – specification - Plywood - Veneer - False ceiling materials - Panels of laminates - Steel - Aluminum and Other Metallic Materials - Composition - Aluminium composite panel - Uses - Market forms - Mechanical treatment. Glass - Ceramics - Sealants for joints - Fibre glass reinforced plastic.

**UNIT 5 MODERN MATERIALS, PLASTERING - PAINT - VARNISHING – DPC****9 Hrs.**

Clay products - Refractory's - Composite materials - Types - Applications of laminar composites Fibre textiles - **Geo-membranes and Geo-textiles for earth reinforcement** – Internal and external plastering materials - white and colour washing - painting, varnishing and distemping - Dampness and fire proofing - anti termite measures.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the applications of basic building materials.
- CO2 - Know the properties and characteristics of cement, lime and steel
- CO3 - Know the production and placing process of concrete.
- CO4 - Assess the usage of timber and composite materials.
- CO5 - Compare the properties of common and alternate building materials.

**TEXT / REFERENCE BOOKS**

- Duggal S.K., "Building Materials", 4<sup>th</sup> Edition, New Age International, 2008.
- Gambhir M.L., "Concrete Technology", 3<sup>rd</sup> Edition, Tata McGraw Hill Education, 2004.
- Gambhir M.L. & Neha Jamwal, "Building Materials, products, properties and systems", Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2012.
- IS456 - 2000: Indian Standard specification for plain and reinforced Concrete, 2011.
- IS4926 - 2003: Indian Standard specification for ready-mixed concrete, 2012.
- Jagadish K.S, "Alternative Building Materials Technology", New Age International, 2007.
- Rajput R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
- Rangwala S.C., "Engineering Materials," Charotar Publishing House, Anand, 1993.
- Varghese P.C., "Building Materials", PHI Learning Pvt. Ltd., New Delhi, 2015.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SCIA1201	CONCRETE AND CONSTRUCTION TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVES**

- To study details regarding properties and testing of building materials.
- To study details regarding the construction of building components. To study properties of concrete and concrete mix design.
- To impart the basic concepts in different types of concrete.

**UNIT 1 INTRODUCTION****11 Hrs.**

Mortar – Types – Sand – properties – uses Timber products: properties and uses of plywood, fibre board, particle board. Iron and Steel –Reinforcing steel – types – specifications. Structural steel – specifications miscellaneous materials (only properties, classifications and their use in construction industry): Glass, Plastics, A.C. Sheets, Bitumen, Adhesives, Aluminium. Cement – Different types – Chemical composition and Properties – Hydration of cement – Tests on cement – IS Specifications – Aggregates – Classification – Mechanical properties and tests as per BIS – Grading requirements – Water – Quality of water for use in concrete.

**UNIT 2 CONCRETE AND ADMIXTURES****9 Hrs.**

Concrete – Aggregates – Mechanical & Physical properties and tests – Grading requirements –Water quality for concrete – Admixtures – types and uses – plasticizers – accelerators – retarders–water reducing agents Making of concrete - batching – mixing – types of mixers –transportation – placing – compacting – curing. Properties of concrete – fresh concrete – workability – segregation and bleeding - factors affecting workability & strength – tests on workability – tests for strength of concrete in compression, tension& flexure Concrete quality control – statistical analysis of results – standard deviation – acceptance criteria – mix proportioning (B.I.S method) – nominal mixes.

**UNIT 3 PROPORTIONING OF CONCRETE MIX****8 Hrs.**

Principles of Mix Proportioning – Properties of concrete related to Mix Design – Physical properties of materials required for Mix Design – Design Mix and Nominal Mix – BIS Method of Mix Design – Mix Design Examples

**UNIT 4 FRESH AND HARDENED PROPERTIES OF CONCRETE****9 Hrs.**

Workability – Tests for workability of concrete – Segregation and Bleeding – Determination of strength Properties of Hardened concrete – Compressive strength – split tensile strength – Flexural strength – Stress-strain curve for concrete – Modulus of elasticity – durability of concrete – water absorption – permeability – corrosion test – acid resistance- destructive and non destructive test.

**UNIT 5 SPECIAL CONCRETES****8 Hrs.**

Light weight concretes – foam concrete- self compacting concrete – vacuum concrete – High strength concrete – Fibre reinforced concrete – Ferrocement – Ready mix concrete – SIFCON – Shotcrete – Polymer concrete – High performance concrete – Geopolymer Concrete- Bio Concrete.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand construction materials, their components and manufacturing process,
- CO2 - Know the properties of concrete and quality control,
- CO3 - Understand the fundamentals of mix design of concrete.
- CO4 - Study the properties of concrete in fresh and hardened concrete.
- CO5 - Understanding the different types of concrete in details.

**TEXT / REFERENCE BOOKS**

1. Arora and Bindra, Building construction, Dhanpath Rai and Sons.
2. Punmia B.C., Building construction. Laxmi Publications.
3. Rangwala S.C., Engineering Materials, Charotar Publishers.
4. Shetty M.S., Concrete Technology, S. Chand & Company.
5. Sahu G.C. & Joygopal Jena., Building Materials and Construction, McGraw Hill Education.
6. Gambhir M.L., Concrete Technology, Tata McGraw Hill.
7. Krishna Raju N, Design of Concrete Mixes, CBS Publishers.
8. National Building Code.
9. Neville A.M. and Brooks.J.J, Concrete Technology, Pearson Education.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****PART A:** 10 Questions of 2 marks each - No choice**PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks**

SCIA1304	HIGHWAY ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To understand the concept of planning, design, construction and maintenance of highways as per Indian Road Congress standards, specifications and methods in Highway Engineering.

**UNIT 1 HIGHWAY DEVELOPMENT, PLANNING AND ALIGNMENT****9 Hrs.**

Introduction to Transportation systems - Highway development in India - Classification of Roads - Planning of roads - Significance of Highway planning - Highway alignment - factors influencing highway alignment - Planning or Engineering surveys for alignment: objectives, conventional and modern methods – Sustainability and its importance in Highway Engineering

**UNIT 2 GEOMETRIC DESIGN ELEMENTS****9 Hrs.**

Cross section of Urban and Rural Roads - Cross sectional elements - Sight distance – Horizontal Curves, Super elevation, Transition Curves, Widening of pavement on curves – Vertical Curves, Gradient (problems included) - Considerations on Hill Roads, Hairpin Bends – Lateral and Vertical Clearance of Underpasses

**UNIT 3 HIGHWAY MATERIALS AND CONSTRUCTION PRACTICE****9 Hrs.**

Highway construction materials and its properties – CBR test on Sub grade soil - Tests on Aggregates - Tests on Bitumen and Bituminous Mix Design - Construction procedure of Bituminous Roads and Cement Concrete Roads – Recycled materials - Quality Control Measures – Construction Machineries

**UNIT 4 PAVEMENT DESIGN****9 Hrs.**

Pavement Components and their role - Types of Pavements: Flexible and Rigid - Design of Flexible and Rigid Pavements (IRC Methods only) - Joints in Rigid Pavements

**UNIT 5 PAVEMENT EVALUATION AND MANAGEMENT****9 Hrs.**

Types of Pavement failures – Pavement Maintenance - Pavement evaluation: Surface and Structural - Pavement Management System - Strengthening of pavements - Highway drainage – Formulation of Highway Project report

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the importance of transportation, characteristics of road transport, history of highway development, surveys and classification of roads.
- CO2 - Study about the geometric design of highways and cross sectional elements of a road.
- CO3 - Study about the materials used for highway construction and the methods to test the quality of those materials.
- CO4 - Understand the concept of design of highway flexible and rigid pavement.
- CO5 - Learn the various types of failures and its remedies and understand the types of evaluation methods of Pavement.
- CO6 - Analyse the concepts of Pavement Management System (PMS) and formulation of highway project report.

**TEXT / REFERENCE BOOKS**

1. Khanna S.K., Justo C.E.G. and Veeraragavan A., "Highway Engineering", NemChand Publishers, 2014.
2. Kadiyali L.R., "Principles and Practices of Highway Engineering", 8<sup>th</sup> Edition, Khanna Technical Publication, New Delhi, 2013.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", SciTech Publications India, Chennai, 2010.
4. Indian Road Congress (IRC), "Guidelines and Special Publications of Planning and Design".
5. IRC – 37 "Guidelines for Design of flexible Pavements", IRC, New Delhi, 2001.
6. IRC: 58, 2002: "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, N. Delhi, 2002.
7. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Ninth Impression, South Asia, 2012.
8. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, 1st Edition, USA, 2011.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SCIA1404	SURVEYING - II	L	T	P	Credits	Total Marks
		3	*	0	3	100

**COURSE OBJECTIVE**

- To determine the area and volume with different plane are calculated with current method, considering with filed observation.

**UNIT 1 HYDROGRAPHIC SURVEY****7 Hrs.**

Tides - Prediction of tides - Tide gauges - Sounding - Method of Locating soundings - Three point problems - Reduction of sounding and Plotting of sounding - stream measurements.

**UNIT 2 AERIAL PHOTOGRAPHY****7 Hrs.**

Aerial Survey - Terrestrial stereo photography - Aerial photography - Scale of vertical photography - Scale of vertical Tilted photograph - Photo interpretation - Parallax.

**UNIT 3 REMOTE SENSING AND GIS****9 Hrs.**

Remote sensing - basic procedure of setting out remote sensing - electromagnetic spectrum - energy interaction with earth surface - remote sensing in India - Global Information system - Hardware of GIS - Software of GIS - vector and raster data - Application of GIS - Remote sensing and GIS

**UNIT 4 ASTRONOMICAL SURVEYING****12 Hrs.**

Astronomical terms and definition - Celestial sphere - Motion of sun and stars - Physical characteristics of the sun, the moon, the planets and satellites - Field observation - spherical trigonometry - Napier's rule of circular parts - determination of hour angle, azimuth, Latitude and longitude of a place and time.

**UNIT 5 TOTAL STATION AND ITS APPLICATION****10 Hrs.**

Total Station - advantages of total station - principles of total station - application of total station - basic elements of total station - parts and accessories - errors - problems.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Study on water bodies with method of locating sounding
- CO2 - Calculate the area by photography image with aerial survey.
- CO3 - Understand the fundamentals of remote sensing and its application in civil engineering.
- CO4 - Study on characteristics of Astronomical survey and their filed observation.
- CO5 - Study on total station with civil related problem..

**TEXT / REFERENCE BOOKS**

1. Kanetkar T.P., "Surveying and Levelling" Vol. I and Vol. II, Pune Vidyarthi Griha Prakashan, 2013.
2. Punmia B.C., "Surveying", Vol. I and Vol. II, Lakshmi Publications(P) Ltd., New Delhi, 2014.
3. Clark D., "Plane and Geodetic surveying", Vol. I and Vol. II, CBS Publishers, New Delhi, 2009.
4. Duggal S.K., "Surveying", Vol. I and Vol. II, Tata McGraw Hill publisher, 2011.
5. Basak N.N., "Surveying and Levelling", Tata McGraw Hill Publisher, 2008.
6. Subramanian R., "Surveying and Levelling", Oxford University Press, 2010.
7. Bhavikatti S.S., "Surveying Theory and Practice", I.K. International Publishing House Pvt. Ltd, New Delhi, 2010.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SCIA1504	SOIL MECHANICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

**COURSE OBJECTIVES**

- To develop an understanding of the relationships between physical characteristics and mechanical properties of soils.
- To understand and experience experimental measurement of the physical and mechanical soil properties commonly used in engineering practice.
- To understand and be able to apply the modeling and analysis techniques used in soil mechanics: (a) Darcy's Law and flow-nets for seepage (b) consolidation models for load-time deformation responses of soils (c) Mohr's -Coulomb models for shear strength behavior of soils.
- To develop good technical reporting and data presentation skills.

**UNIT 1 SOIL PROPERTIES****9 Hrs.**

Objectives and Values of Geotechnical Engineering - Nature of soil, Formation of soil and functional relationships - types of soil and the soil properties -Phase relations - Index properties - Specific gravity using pycnometer and specific gravity bottle - Grain size analysis - sieve analysis and hydrometer analysis - Consistency of soils - Atterberg's limit - soil classification for Engineering purposes - Classification of coarse grained and fine grained soil as per BIS - Soil deposits in India.

**UNIT 2 SOIL WATER AND WATER FLOW****7 Hrs.**

Effective and Neutral stress – capillary stress – Permeability measurement in the laboratory and field pumping in and pumping out tests – Factors influencing permeability of soils – Seepage – **Introduction to Flow net – Simple problems.**

**UNIT 3 COMPRESSIBILITY AND CONSOLIDATION****9 Hrs.**

Compaction - Proctor test and Modified proctor test - Concept of OMC and maximum dry density - Zero air voids line - Factors influencing compaction - Effect of compaction in soil properties - Difference between consolidation and compaction - Definition - Concepts of coefficient of compressibility - Components of settlement Immediate and consolidation settlement - Terzaghi's one dimensional consolidation theory - Governing differential equation -Laboratory consolidation test - Field consolidation curve- Introduction to sand drain, radial drainage and vacuum consolidation - Problems on final and time rate settlement.

**UNIT 4 STRESS DISTRIBUTION AND SHEAR STRENGTH****11 Hrs.**

Stress distribution in soil media - Boussinesque's and Westergaard's equations for vertical pressure due to point loads and uniformly distributed loads – assumptions and limitations - pressure bulb - Newmark's influence chart - principle, construction and use - line loads and strip loads -Shear strength of cohesive and cohesionless soils Mohr's Coulomb failure theory - Saturated soil - Strength parameters - Measurement of shear strength, Direct shear, Triaxial compression, UCC and Vane shear tests - Types of shear tests based on drainage and their applicability Drained and undrained behaviour of clay and sand - Stress path for conventional triaxial test.

**UNIT 5 SLOPE STABILITY****9 Hrs.**

Slope failure mechanisms - Modes - Infinite slopes - Finite slopes -Total and effective stress analysis - Stability analysis for purely cohesive and Cohesion less soils - Method of slices - Modified Bishop's method - Friction circle method - Stability number - problems - Slope protection measures.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the concepts of soil formation and index and engineering properties of soil.
- CO2 - Calculate effective and total pressure of soil and also the coefficient permeability of soil.
- CO3 - Understand the fundamentals and difference of compaction and consolidation.
- CO4 - Apply the concepts of compressibility and solve problems related with consolidation and settlement
- CO5 - Understand the concepts of vertical stress distribution and procedures to conduct various shear tests, solving problems in finding shear parameters.
- CO6 - Analyze various slope failures, gain knowledge about the slope protection methods.

**TEXT / REFERENCE BOOKS**

1. Punmia B.C, "Soil mechanics and Foundations", Laxmi Publications, 1998.
2. Terzaghi K Pech. R.B "Soil mechanics in Engineering Practice", John Wiley Ltd., 2012.
3. Lambe T.W & Whitman, "Soil mechanics", John Wiley Ltd., 1976.
4. Alam Singh, "Soil Engineering", Asia Publications, 2006.



5. Murthy V.N.S, "A text book of Soil Mechanics and Foundation Engineering", CBS Publishers & Distributors Pvt. Ltd., 2011.
6. Sourabh Kumar Soni, "Geo Technical Engineering", S.K.Kataria & Sons, New Delhi, Edition, 2013.
7. Cheng Liu & Jack Evett , "Soil Properties: Testing, Measurement and Evaluation", Pearson; 4<sup>th</sup> Edition, 1999.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SCIA1701	RAILWAYS, AIRPORT AND HARBOUR ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To expose the students to Railway planning, design, construction and maintenance
- To gain knowledge on planning and design principles of Airports and Harbours.

**UNIT 1 RAILWAY PLANNING****9 Hrs.**

Development of railways in India - Comparison of roadways and railways - Components of a permanent way and its functions - Rails, Gauges and its selection, Sleepers, Ballast, Formation, Rail fittings and fastenings - Coning of wheels Defects in rails: creep and shift in rails, Track Stress - Gradient - Super elevation and Negative super elevation - Permissible speed on curve (Problems included) - Widening of gauge on curves.

**UNIT 2 RAILWAY CONSTRUCTION AND MAINTENANCE****9 Hrs.**

Alignment surveys - Track construction - Calculation of Materials required for track laying – Stabilization of track on weak soil - Track maintenance - Track drainage - Types of stations and Types of station yards: Passenger, Goods, Marshalling and Locomotive - Station equipments - Introduction to Modern Developments in Railways.

**UNIT 3 POINTS AND CROSSINGS, URBAN RAILWAYS****7 Hrs.**

Types of Points / Switches - Types of crossing - Design calculation of Turnout - Types of Track junctions - Types of signals and their location – Introduction to Railways in Metro Cities.

**UNIT 4 AIRPORT PLANNING AND DESIGN****10 Hrs.**

Air transport characteristics - Classification of airports - Factors influencing the selection of new airport site and ICAO stipulations - Layout characteristics, Socio-economic characteristics of the catchment area - Components of Airport - Runway Orientation - Wind Rose Diagram - Problem on Basic and Actual runway length - Aircraft Parking system - Drainage - Airport Zones - Runway and Taxiway Markings and lighting - Design standards and planning of Airport as per Indian condition.

**UNIT 5 WATERWAYS****10 Hrs.**

General terminologies - Ports: Classification, Requirements - Docks: Classification - Harbour: Classification, Requirements - Harbour Layout and Terminal Facilities - Coastal Protection Structures – Pier, Breakwaters, Wharves, Jetties, Quays, Fenders, Dolphins and Landing stage – Wave action on coastal structures – coastal protection and zone under coastal regulation - Inland Water Transport and Container transportation.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, students will be able to

- CO1 - Understand the terminologies, materials and geometry of railway track.
- CO2 - Know the process of track laying and maintenance, functions of yards.
- CO3 - Know the Types of Track junctions and uses of signals.
- CO4 - Understand the characteristics airport and air transport.
- CO5 - Understand the terminologies and characteristics of harbor.

**TEXT / REFERENCE BOOKS**

1. Arora S P and Saxena, "Railway Engineering", Dhanpat Rai Publishers, New Delhi, 2001.
2. Horren Jeff, "Airport, Planning & Design" Chapman Hall, London, 2000.
3. Khanna S.K., Arora M.G. and Jain S.S., "Airport Planning and Design", NemChand and Bros., Roorkee, 2012.
4. Mundrey J.S., "Railway Track Engineering", McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2013.
5. Oza H.P. and Oza G.H., "Dock and Harbour Engineering", Charotar Publishing House, 2013.
6. Rangawal S C "Railway Engineering" Charotar Publishers, Anand, 2002.
7. Satish Chandra and Agarwal M.M., "Railway Engineering", Oxford University Press, New Delhi, 2013.
8. Saxena Subhash C. and Satyapal Arora, "A course in Railway Engineering", 7<sup>th</sup> Edition, Dhanpat Rai & sons, Delhi, 2009.
9. Srinivasan R. and Rangwala S.C., "Harbours" Charotar Publishers, Anand, 1999.
10. Subramanian K.P. "Highways, Railways, Airport & Harbour Engineering", V Scitech Publications (India), Chennai, 2010.
11. Venkatramaiah C., "Transportation Engineering, Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels", Universities Press (India) Pvt. Ltd., Hyderabad, 2015.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

<b>SCIA2302</b>	<b>STRENGTH OF MATERIALS LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Total Marks</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>100</b>

**COURSE OBJECTIVE**

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

**SUGGESTED LIST OF EXPERIMENTS**

1. By conducting tension test, draw the stress-strain curve on mild steel.
2. Compression Test on bricks and Wood.
3. Deflection Test on mild steel beam - Verification of Maxwell theorem
4. Deflection Test on Aluminium beam - Verification of Maxwell theorem
5. Tension Test on closed coiled helical springs.
6. Compression Test on open coiled helical springs.
7. Impact test on metal specimen using a Charpy/Izod method.
8. Shear test on metal specimen by using U.T.M.
9. Hardness values of Steel, Copper and Aluminum by using Brinell hardness testing machine.
10. Hardness values of Steel, Copper and Aluminum by using Rockwell hardness testing machine.
11. Hardness values of Steel, Copper and Aluminum by using Vicker's hardness testing machines.
12. Torsion test on metal specimen by using Torsion Testing Machine.

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Gain knowledge in properties of materials
- CO2 - Gain knowledge in components of structural elements

**PROGRAMME: M.E.  
STRUCTURAL ENGINEERING  
CURRICULUM**

<b>SEMESTER 1</b>										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA5101	Advanced Mathematics	3	0	0	3	50	50	1
2	Theory	SCIA5101	Advanced Reinforced Concrete Structures	3	0	0	3	50	50	2
3	Theory	SCIA5102	Theory of Elasticity and Plasticity	3	0	0	3	50	50	3
4	Theory	SCIA5103	Matrix Method of Structural Analysis	3	0	0	3	50	50	4
5	Theory	SCIA5104	Experimental Stress Analysis and Techniques	3	0	0	3	50	50	5
6	Practical	SCIA6101	Structural Analysis Lab - I	0	0	4	2	50	50	6
7	Practical	SCIASEM1	Seminar	0	0	2	1	50		-
Total Credits for Semester 1 - 18										
Total Marks for Semester 1 - 650										

<b>SEMESTER 2</b>										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SCIA5201	Finite Element Analysis	3	0	0	3	50	50	7
2	Theory	SCIA5202	Structural Dynamics	3	0	0	3	50	50	8
3	Theory	SCIA5203	Advanced Design of Steel Structures	3	0	0	3	50	50	9
4	Theory	SCCA9501	Industry 4.0	2	0	0	2	50	50	10
5	Theory		Elective - 1	3	0	0	3	50	50	-
6	Theory		Elective - 2	3	0	0	3	50	50	-
7	Practical	SCIA6201	Structural Analysis Lab – II	0	0	4	2	50	50	11
Total Credits for Semester 2 - 19										
Total Marks for Semester 2 - 700										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS,  
CAE – CONTINUOUS ASSESSMENT EXAMINATION  
ESE – END SEMESTER EXAMINATION

<b>SEMESTER 3</b>										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SCIA5301	Seismic Design of Structures	3	0	0	3	50	50	12
2	Theory		Elective - 4	3	0	0	3	50	50	-
3	Theory		Elective - 5	3	0	0	3	50	50	-
4	Theory		Elective - 6	3	0	0	3	50	50	-
5	Practical	SCI A6301	Structural Engineering Lab	0	0	4	2	50	50	13
6	Practical	SCIASSEM2	Seminar	0	0	2	1	50		-
7	Project	S38APROJ1	Project Work (Phase - 1)	0	0	6	3	50	50	-
Total Credits for Semester 3 - 18										
Total Marks for Semester 3 - 650										

<b>SEMESTER 4</b>										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Project	S38APROJ2	Project Work (Phase – II)	0	0	30	15	50	50	-
Total Credits for Semester 4 - 15										
Total Marks for Semester 4 - 100										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS,  
 CAE – CONTINUOUS ASSESSMENT EXAMINATION,  
 ESE – END SEMESTER EXAMINATION

PROFESSIONAL ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SCIA7001	Advanced Concrete Technology	3	0	0	3	50	50	14
2	SCIA7002	Mechanics of Composite Materials	3	0	0	3	50	50	15
3	SCIA7003	Maintenance and Rehabilitation of Structures	3	0	0	3	50	50	16
4	SCIA7004	Design of Bridges	3	0	0	3	50	50	17
5.	SCIA7005	Theory of Plates and Shells	3	0	0	3	50	50	18
6	SCIA7006	Offshore structures	3	0	0	3	50	50	19
7	SCIA7007	Design of Sub Structures	3	0	0	3	50	50	20
8	SCIA7008	Design of Steel Concrete Composite Structures	3	0	0	3	50	50	21
9	SCIA7009	Prestressed Concrete Structures	3	0	0	3	50	50	22
10	SCIA7010	Design of Tall Buildings	3	0	0	3	50	50	23
11	SCIA7011	Stability of Structures	3	0	0	3	50	50	24
12	SCIA7012	Nonlinear Analysis of Structures	3	0	0	3	50	50	25
13	SCIA7013	Structural Optimization	3	0	0	3	50	50	26
14	SCIA7014	Industrial Structures	3	0	0	3	50	50	27
15	SCIA7015	Energy Efficient Structures	3	0	0	3	50	50	28
16	SCIA7016	Environmental Engineering Structures	3	0	0	3	50	50	29
17	SCIA7017	Prefabricated Structures	3	0	0	3	50	50	30
18	SCIA7018	Design of Structures for Dynamic Loads	3	0	0	3	50	50	31

Semester	Theory courses (including elective courses)			Practical Courses (including PT and project)		
	Total no.	Total Credits	Total Marks	Total no.	Total Credits	Total Marks
1	5	15	500	2	3	150
2	6	17	600	1	2	100
3	4	12	400	3	6	250
4	0	0	0	1	15	100
<b>Over all Total</b>	15	44	1500	8	26	600

Overall total credits for M.E Structural Engineering	70
Overall total marks for M.E Structural Engineering	2100

<b>SCCA9501</b>	<b>INDUSTRY 4.0</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Total Marks</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>100</b>

**UNIT1 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING****9 Hrs.**

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

**UNIT 2 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT****9 Hrs.**

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies

**UNIT 3 SMART MANUFACTURING****9 Hrs.**

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies- Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

**UNIT 4 SMART WORLD****9 Hrs.**

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

**UNIT 5 CYBER PHYSICAL SYSTEMS****9 Hrs.**

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Deep Learning, Gamification, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : Case Studies.

**Max. 45 Hrs.****TEXT / REFERENCE BOOKS**

1. William D. Callister, "Materials Science and Engineering, An Introduction", John Willey and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice", Prentice Hall India Pvt. Ltd, 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo JorgeBartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, 2019.
4. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
5. Oliver Grunow, "Smart Factory and Industry 4.0. The current state of Application Technologies", Studylab Publications, 2016.
6. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016.
7. Sang C. Suh, U. John Tanik, John N. Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.