Programme Name/s : **Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**

Programme Code : **CE/ CR/ CS/ LE**

Semester : **Sixth**

Course Title : **BUILDING SERVICES**

Course Code : **316310**

I. RATIONALE

Buildings serve several societal needs â€“ primarily as protection from adverse weather conditions, space for various activities like bathing & sanitation, food, rest, study, quite sleep, privacy and security to comfortably live and work. Building services are the systems installed in buildings to make them comfortable, functional, efficient and safe. They can include Plumbing, lighting, fire safety, IOT (Internet of Things), and so on. Building Services Engineers are the people who make this happen. The knowledge of building services is necessary to maintain the functional requirements of the building by a civil technologists. As buildings are becoming more complex and more modern, it is essential to include the same in the Civil Engineering curriculum. This course is designed to enhance the skills of diploma students in the domain of building services.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified expected outcomes through various teaching learning experiences:
Execute the building services for creating human comfort in the buildings.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Draw the layout of domestic water Supply and gas supply line for the given area.
- CO2 - Estimate the space requirements for vertical communication services
- CO3 - Propose the relevant fire safety equipment for a multi-storeyed building
- CO4 - Install the proper system of rain water harvesting and solar water heater system for the given buildings
- CO5 - Suggest the relevant advanced building services system for the given building.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/ s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316310	BUILDING SERVICES	BSE	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 2 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Classify the building as per the provisions mentioned in National Building Code.. TLO 1.2 Develop the BMS for the given type of civil structure for the given context TLO 1.3 Explain the procedure of laying the water supply pipe line for the given specifications. TLO 1.4 Design the pipeline system used to install the Hot water supply system. TLO 1.5 Explain domestic pipe gas system for a residential building.	**Unit - I Introduction to Building Services** 1.1 Introduction to building services, Classification of buildings as per national building code, Necessity of building services, Functional requirements of building. Different types of building services (Enlist) 1.2 Building Management Services - Introduction to BMS (Building Management Services), Role and responsibilities of Engineer 1.3 Importance of plumbing, AHJ (Authority Having Jurisdiction) approval, Plumbing Terminology and fixtures: Terms used in plumbing Different types of plumbing fixtures, valves, shapes/ sizes, capacities, Suitable situation.Use of Water sensors for overhead tanks, Centralized RO system, drinking water cooler system 1.4 Hot water supply system. Introduction, Requirements, Types, Safety Features,Centralised hot water System. (*IKS-Red Fort-Hammam-hot or vapour baths, with heating arrangements) 1.5 Domestic pipe gas supply- introduction, component parts layout of domestic pipe Gas supply ,advantages and disadvantages	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit Presentations
2	TLO 2.1 Explain the safety measures required for installing the Lifts TLO 2.2 Mention the factors considered while installing escalator for public building structure with justification TLO 2.3 Draft the specifications required for construction of ramp required for physically handicapped and elderly persons for the given type of the building structure.	**Unit - II Vertical communication** 2.1 Vertical Communication in building- introduction, necessity and types- Lifts: Introduction, Necessity, Types Component parts, Safety measures, Calculation of space enclosure to accommodate lift services, design aspect 2.2 Escalators: Introduction, Necessity, Types, Uses, Component parts, Safety measures, Calculation of space enclosure to accommodate Escalators services, Design aspect 2.3 Ramp: Introduction, Necessity, Gradient calculation, Safety measures, Calculation of space enclosure to accommodate Ramp services, special features for physically handicapped and elderly. (*IKS-Use of climbers and Parambya for vertical communication)	Lecture Using Chalk-Board Presentations Site/Industry Visit Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain the importance of fire safety in a building. TLO 3.2 Outline the installation layout of Fire detection instruments TLO 3.3 Examine fire safety and evacuation process w.r.t given points TLO 3.4 Describe the NBC provisions related to Fire protection system for a multi-storeyed building TLO 3.5 Understand the provisions of Maharashtra Fire Prevention and Life Safety Measures Act, 2006	**Unit - III Fire Safety** 3.1 Introduction to Fire Safety Definition and importance of fire safety Causes and consequences of fire incident 3.2 Fire prevention safety measures in buildings- Fire detectors (smoke/ heat), manual pull stations, Fire alarm control panel, alarm system audible & visual alarms, Fire suppression systems (sprinklers,) 3.3 Fire Safety Equipment and Systems -Types of fire extinguishers (foam, gas suppression) and their applications, fire balls, Fire hoses, hydrants, and pumps, Emergency Response and Evacuation (*IKS-Use of Ghongadi for fire resistance) 3.4 Fire Safety Regulations and Standards-National Building Code of India (NBC) fire safety norms, Fire safety rules in residential, and Public buildings 3.5 Gr-Maharashtra Act No. III Of 2007 (Maharashtra Fire Prevention and Life Safety Measures Act, 2006.for the type of building A,B,C)	Video Demonstrations Presentations Lecture Using Chalk-Board Site/Industry Visit
4	TLO 4.1 Design the rain water harvesting system for the given structure TLO 4.2 Suggest the relevant Solar system required for the given site condition with justification. TLO 4.3 Explain the applicability of PM â€“ Surya Ghar: Muft Bijli Yojana-with its consequences on beneficiary. TLO 4.4 Explain the Significance of Grey water system for the given building structure	**Unit - IV Natural resources conservation services** 4.1 Components of a RWH system (Catchments, gutters, conduits, filters, Storage facility, Recharge structures etc.), Advantage, Application, potential and factors affecting, planning, designing, construction and maintenance of RWH for residential building 4.2 Concept of SWH (Solar water heating),component parts of various system of SWH (heat transfer, propulsion, passive direct system, active direct system, Do-it-yourself),Layout,design ,principles, specification, installation and maintenance 4.3 PM â€“ Surya Ghar: Muft Bijli Yojana-details & benefits. 4.4 Grey water-introduction, Constitutes,Application,Management and, Distribution Pattern,	Presentations Video Demonstrations Site/Industry Visit
5	TLO 5.1 Select relevant system of lighting for the given building with justification TLO 5.2 propose the relevant light control systems to be adopted in the given context. TLO 5.3 Explain the significance of providing air conditioning system in the given type of building TLO 5.4 Inference the use of smart technologies for improvement of building function	**Unit - V Advance building services** 5.1 Introduction to Electrification: Lighting-Introduction, Necessity, Concept of lighting, types of lighting, factors influencing the brightness of room 5.2 Types of light control (Manual switch, Remote switch, Timer switch and Photo-electric cell switch), Door Bells- Concept, Locations, Types, Need, Applications, Lightning arrester-definition, Uses, Location. 5.3 Overview of HVAC system for building and centralized water cooling system. (@IKS-Jharokhas in HAWA MAHAL,Palace of winds) 5.4 Smart Building Technologies. Charging points for e-vehicles, Domestic surveillance system-component parts, uses IOT in building services, Smart gates, Kitchen Chimneys-Necessity/use, Size & types of chimneys ,selection of appropriate size	Video Demonstrations Presentations Site/Industry Visit Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 IdentifyÂ theÂ Â components of building services of given building	1	*Prepare a report on various components of building services of given building	2	CO1
LLO 2.1 Identify theÂ components of water supply system observed in multistory building/public building in relevant video /simulation / photographs	2	*Prepare a report on observed components of water supply system from the given video/simulation / photographs of any multi-story building/ public building in your area.	2	CO1
LLO 3.1 IdentifyÂ theÂ Â components of gas supply system observed in the residential/commertial building of relevant video /simulation /photographs	3	*Prepare a report on observed components parts on the layout of gas supply system for a residential / commercial building by viewing the relevant given video/simulation/photographs.	2	CO1
LLO 4.1 Determine theÂ space requirements for the escalator	4	Compute the space requirements for the given type of escalator for the given type of building as per guidelines of national building code	2	CO2
LLO 5.1 Determine the space requirements for the lift for a given residential building (upto,5,10,15 storey)	5	*Compute the space requirements for the lift for the given type of building as per guidelines of national building code	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Write the specifications & operation of a fire extinguisher.	6	*Prepare a report on the specifications, supplier name, its capacity, fire rating, dimensions, discharge type etc along with the method of using it in case of fire hazard	2	CO3
LLO 7.1 Â Prepare layout plan /mapÂ of Fire safety equipmentâ€™s	7	Mark the locations of fire safety equipment's installed in a building in your nearby area.	2	CO3
LLO 8.1 EstimateÂ Â rain water harvesting potential for the given residential building.	8	*Estimate the rain water harvesting potential for the given plan of the residential building (single story load bearing structure) and considering average annual Rainfall of your locality	2	CO4
LLO 9.1 Design the proposed rain water harvesting system for residential building	9	Design the proposed rain water harvesting system for estimated rain water harvesting potential determined in practical no.8 with necessary sketch, diagram, and specifications.	2	CO4
LLO 10.1 Â Discuss rain water harvesting system for the given area	10	Design the rain water harvesting system for the given area of the multi-story framed structure residential building. .	2	CO4
LLO 11.1 Design layout of a solar water system	11	*Design layout of a solar water system with diagram for a residential building with given data	2	CO4
LLO 12.1 Collect data of lighting system provided for residential/public building in your area.	12	Prepare a report on lighting system to be provided for residential /public building in your area.	2	CO5
LLO 13.1 PrepareÂ budget for electrical fittings required for a dwelling unit excluding labour cost.	13	*Prepare the budget on the basis of Estimation of the quantities of the electrical fittings, points, switches and wiring system required etc. for the given type of dwelling unit.	2	CO5
LLO 14.1 Write IOT application in a building	14	*Prepare a report on IOT in building services by viewing video /simulation /photographs	2	CO5
LLO 15.1 DetermineÂ Â size & type of chimney for the given residential /public building	15	Determination of size & type of chimney for the given residential /public building by viewing plans	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Visit any three buildings near by your institute and classify them in accordance with the provisions made in National Building Code in report form
- Prepare a sketches consisting of components of modern building services(any five).
- Prepare a report on BMS including a case study
- Prepare a report on modern Fire Safety
- Make a model of rain water harvesting showing its components
- Prepare a report on advance building service

Assignment

- Visit any three buildings near by your institute and classify them in accordance with the provisions made in National Building Code in report form
- Identify the components of building services by inspecting the nearby buildings to prepare a detailed report w.r.t. adequacy, deficiency and exceeding the requirement.
- Collect the technical brochures of the different components of building services from the local market/internet to present in report form
- Visit any building certified by Building Management Services to record the important features that has converted it into green building and submit a report.
- Estimate the RWH and SWH potential for your house and institute building.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Model of a civil engineering structure showing various components.	1,2,3

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
2	Chart showing details of lift, escalator and ramp.	4,5

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Building Services	CO1	7	2	4	4	10
2	II	Vertical communication	CO2	10	2	8	6	16
3	III	Fire Safety	CO3	10	6	4	6	16
4	IV	Natural resources conservation services	CO4	10	2	4	10	16
5	V	Advance building services	CO5	8	2	4	6	12
Grand Total				**45**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work (60% weightage to process related and 40 % weightage to product related) , Assignment, Micriproject,Question and Answers in class room.

Summative Assessment (Assessment of Learning)

- Pen and Paper Test. (Written Test),Practical Examination, Oral Exam.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2	PSO- 3
CO1	3	3	2	2	2	2				
CO2	3	3	2		2	2				
CO3	3		3	3		3				
CO4	3		3		2		3			
CO5	3	3	3		2	3				

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Mantri, Sandeep	The A to Z of Practical Building Construction and its Management	Satya Prakashan, New Delhi ISBN-13: 978-8176849692
2	Deolalikar, S. G.	Plumbing Design and Practice	McGraw-Hill, New Delhi, 2004 ISBN: 9780074620694
3	Bag, S. P.	Fire Services in India: History, Detection, Protection, Management	Mittal Publications, New Delhi, 1995, ISBN 8170995981
4	Akhil Kumar Das	Principles of Fire Safety Engineering: Understanding Fire and Fire Protection	PHI Learning Pvt. Ltd, New Delhi. 2014, ISB:9788120350380
5	BIS	National Building Code Part1, 4, 8, 9	Bureau of Indian Standard, New Delhi
6	BIS	IS 12183(Part 1):1987 Code of practice for plumbing in multistoried buildings	Bureau of Indian Standard, New Delhi
7	BIS	2022 Uniform plumbing code â€“ India (UPC-I)	Bureau of Indian Standard, New Delhi

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=Zo84UaSVFCM&t=2s	Identification of components of water supply system observed in multistory building relevant
2	https://www.youtube.com/watch?v=tW2w14YIQ98	Design the proposed rain water harvesting system for residential building
3	https://www.youtube.com/watch?app=desktop&v=SuzRufz4hQo	IOT application in a building
4	https://www.youtube.com/watch?v=fkki04h8TCM	Determination of size & type of chimney for the given residential /public building
5	https://www.youtube.com/watch?v=0LNklcBhl_Q&list=PLp6ek2hDcoNCb0R8gxk1WzpTN94eXs9vb	Fire protection, maintenance in building services

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students