

Masters of Architecture (Building Services)

INTRODUCTION:

Understanding of building physics is important for its efficient and optimum functioning. Building physics is a science that includes building thermodynamics and application of other principles of physics to the built environment. Building services, which render the shell or structure into a functional habitat, become integral and inevitable to the architects. To comprehend the very basic concept of building services and their application, it is important to study building physics.

Master of Architecture (Building services) is a course designed keeping in mind the needs of contemporary architecture and architect's reliance on the services. The course has been structured in a manner, so that a graduate student of architecture is able to get a greater understanding of building physics. The course takes the perspective of technology playing an important role in shaping the building, and thus emphasizes on the role of digital application in architecture. The highlight of this program is that it not only focusses on the building thermodynamics, but also makes the student aware of the consequences of their conscious decisions and choices on the built environment.

The syllabus is designed and updated, in conjunction with the latest ongoing researches in the field. The syllabus conforms with the latest on-going trends in the world of building physics both academically and professionally. Professional perspective has been given due consideration in the syllabus, as it is important to understand the efficient and optimum functioning of the built environment.

The course has been structured in two tiers. Tier one deal with basic concepts of building physics along with certain generalized aspects. Tier two delves in detail about various services and building thermodynamics. The student is faced with challenge of designing of various building services for an ongoing project, thus building his/her confidence of facing the issues and concerns of professional industry.

MAR 101:**Architectural Philosophy**

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

OBJECTIVE:

- To make a base of sound understanding of the fundamentals and theories in Architecture.
- To critically analyze the ongoing practices and formulate an understanding of the same.

METHODOLOGY:

- Lectures and presentations based on field observations, surveys, web search and library studies.

CONTENTS:

- Towards Analytical approach of Architecture: the concept and theory of Period, Place, Purpose, People and Philosophy.
- History, Theory, Criticism, Post Mortem and Anti Mortem
- Time, Function and Alterity in Architecture
- Complexity and Contradiction in Architecture
- Building Philosophy – Towards Architecture theory of Conceptualize, Communicate and concretize.
- Architectural Theory and Practice in International and Indian context
- Architectural Development in International and Indian context: 21st century changes with the advent of Foreign Direct Investment in Architecture.
- Ethics of Architecture – Objectivism

READINGS:

- ***Architectural Philosophy: Repetition, Function, Alterity by Andrew E. Benjamin***
- ***Architectural Reflections: Studies in Philosophy and Practice of Architecture By Colin St. John Wilson, Roger***
- ***Modern Architectural Theory Harry Mallgrave***

MAR 102: Contemporary Architecture

CLASSES/ WEEK		MARKS				EXAM HOURS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>	
2	2	75	75	-	150	3

OBJECTIVE:

- To identify the theories, movements and buildings that have led to new forms.
- To recognize social, political pressures behind contemporary architecture.

METHODOLOGY:

- Lectures and presentations based on field observations, surveys, web search and library studies.

CONTENTS:

- Issues critical for present times: globalization, technology and cognitive sciences, the environment and cultural politics.
- Formal and theoretical resonance of the same in a host of movements: the techno fantasist movement of the 1960's, " post modern" semiosis, phenomenology, Third World "social modernism", vernacularism, post modernism, cybernetics and so on.
- Societal dynamics on the socio economic and politico paradigms: post structuralism and psychoanalysis as well as current debates in globalization, urban geography and mass customization, and post criticality among others.
- Transformation of contemporary architecture in Indian scenario- 1920- 1950s, 1950-1980s, 1980-2000, 21st century.

Students will be looking at buildings, writings and movements as part of evolving critiques of the modernism from 1950s onwards; in doing so students will come to examine the manner in which modernism was both critically unraveled and reinvented at different movements of its aftermath.

TEXT AND REFERENCES

Text:

- *Frampton K (1980) Modern Architecture: A Critical History , London Thames and Hudson*
- *Jenks C. (1985) Modern Movements in Architecture. Harmondsworth Penguin Sharp D. (1991) Twentieth Century Architecture. London Lund Humphries.*

MAR 103: Contemporary Technology

CLASSES/ WEEK		MARKS				EXAM HOURS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT	
2	2	50	50	-	100	3

OBJECTIVE:

- To understand the contribution made by new materials and technology to contemporary buildings
- To understand the construction process
- Development of strategies for collaboration between disciplines

METHODOLOGY:

- The methodology of imparting information should be lectures and presentations citing examples and case studies.

CONTENTS:

- Statics of Architectural Structures: Structural Morphology, Basic structural elements and force systems.
- Building systems: Performance requirements, Identification and specification of elements
- Sustainable strategies Best practices, Resource Efficiency, upcoming issues and ratings
- Materials: Contemporary, structural and otherwise
- Systems integration
- Building Codes

TEXT AND REFERENCES

Text:

- *Energy efficient Buildings by Wagner Walter*
- *Design for Environment by Mackenzie*
- *Energy Efficient Buildings in India by Milli Majumdar*
- *Earth Construction by Houben Hug*

References

- *Mehrotra R " Architecture in India: Since 1990", Pictor Publishing Pvt Ltd, 2011*
- *Smith K " Introducing Architectural Theory", Routledge, 2012*

MARC 105: Integrated Building Services

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	0	50	50	-	100	3	4

OBJECTIVE:

- To understand the importance of building services in the design of buildings.
- Provide students the basic concepts and thorough knowledge and operation of building services in modern, large high rise buildings complexes

METHODOLOGY:

- The methodology of imparting information should be lectures and presentations citing examples and case studies.

CONTENTS:

- **HVAC Services:** Basics of air conditioning, air condition working, HVAC Comfort principles, HVAC Components and systems.
- **Electrical Services:** In coming supply and distribution in buildings, Electric safety and risk assessment, Concept of fault level, Over current protection
- **Fire Services:** Basic fire extinguishing systems viz Water based, pedestal fire hydrant systems, total flood gas protection systems, smoke management systems etc.
- **Lighting Services:** Photometry and colorimetry, lighting equipment and systems, lighting calculations, day lighting.
- **Building Acoustics:** Acoustics fundamentals, Acoustics design and planning, vibration
- Basic principles involved in design of Plumbing services, Solar water Heating, Rainwater harvesting etc.

TEXT AND REFERENCES

Text:

- *Fire Safety in Buildings* by V K Jain
- *Fire Protection and Prevention* by barendra Mohan Sen
- *Energy Efficient Buildings in India* by Milli Majumdar

References

- Mehrotra R “ *Architecture in India: Since 1990*”, Pictor Publishing Pvt Ltd, 2011

MAR 104: E I A & Natural Resources

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

OBJECTIVE:

- To introduce the students with the theory and practice of Environmental Impact Assessments for proposed projects
- To emphasize on the preservation of natural resources.
- To discover the relevance of natural resource management in design and planning of regional areas.

METHODOLOGY:

- Classroom teaching through lectures and presentation.
- Conducting exercises on EIA or introducing the preparation of a report for a project.

CONTENTS:

- **INTRODUCTION**
 - Understanding Ecosystems: General Structure and Function: Types of Biogeochemical cycles; Carbon cycle, Global water cycles, nitrogen cycle
 - Natural elements water, vegetation and land.
- **EIA**
 - from theory to the practical
 - What data is required, how this data should be collected and interpreted, and significance of the data
 - Effectiveness of the assessment methods
 - What issues should be addressed in the terms of reference (TOR)
 - Tools and thumb rules available to evaluate the environmental impact of projects
 - Better understanding of the EIA process – from screening, scoping, data collection to impact assessment as well as the role of public consultation
 - Better understanding of the environmental and social impacts of the industrial and developmental projects
 - Better ability to review EIA reports and identify its strengths and weaknesses
 - Increased ability to play active role in post-EIA monitoring.
- **NATURAL RESOURCES**
 - Introduction - Settlements in relation to regional landscape resources.
 - Microclimate: Definition and characteristics. The role of Natural Elements
 - Air pollution and Air pollution monitoring and quality criteria
 - Threat natural resources; urban environmental issues such as solid waste management, air quality, conservation of water resources and vegetation cover.
 - Natural resources specific to region types: for example: coastal, hills, deserts and plateau regions etc.

MAR 106:**Research Methodology**

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	2	50	50	-	100	3	4

OBJECTIVE:

- To enhance the students' generic research, communication skills and critical analytical ability

METHODOLOGY:

- Lectures, Project work and tutorials.

CONTENTS:**PART (A)****Unit I: Introduction, types of Research**

Foundation: Its Nature and Scope, plagiarism

Scientific Research: Steps of scientific methods and its scope in Architectural research

Qualitative Research Paradigm: Assumption, Nature and Scope, Action Research, Pure and Applied Researches in Architecture.

Unit II: Research Methods: Historical, Survey, Experimental, Case Study, Ethnographic, Visual Research

Unit III: Research Design: Meaning and Importance

- Sample and Sampling Design: Concepts of Population Sample, Representative Sample, Probability and Non Probability, Techniques of Sampling
- Tools and Techniques of Research: Characteristics of Good Tools, Questionnaire and Interview, Observation, Tests, Scale and Types

Unit IV: Preparation of Research Proposal:

Research Problems, Research Objectives, Research Questions, Hypothesis, Operational Variables, Review of Related Literature, Research Design, Limitations and Delimitations

Report Writing, Purpose, Format, Characteristics of Good Research report

PART (B): Branch Specific**Unit V: Descriptive Statistics:**

Data: Nature and types, Normal Probability Curve: Skewness and Kurtosis

Measures of Central tendencies, Measure of Variability, Measures of Correlation: Pearson's correlation and Spearman's Rho

Unit VI: Inferential Statistics (Parametric)

Significance of Statistics, Concept of Null Hypothesis, Level of Significance, T-Test

Unit VII: Inferential Statistics (Non Parametric)

Chi Square Test, Median R Test, Mann-Whitney Test.

Unit VIII: Analysis of Qualitative Data

Editing, Coding of data, Content Analysis

MAR 127(BS): Dissertation-I (BS)

CLASSES/ WEEK		MARKS				EXAM HOURS
<i>L</i>	<i>ST/T</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>	
2	2	50	--	50	100	--

DISSERTATION-I

OBJECTIVE:

- To understand the basic principles of Building Services that would be pertinent to simple and advance design building services.
- The idea is to present a hypothesis for anyone building service design and to prove its validity through cases studies and designing of a multistoried commercial, institutional or residential building.

METHODOLOGY:

- The methodology of imparting information should be studio exercises and presentations based on the theory taught in the theory subjects.
- The basic understanding and application of major building services which will act as foundation for the advance form of building services which will come in subsequent semesters.
- The students have to submit three synopses, out of which one would be approved.
- Final submission would be in the form of a report which would include the final synopsis.

MAR 202

Intensive Humanities

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	0	25	25	-	50	3	2

OBJECTIVE:

- To study the social, economic and psychological factors responsible for shaping and functioning of the Human settlements and hence the built environment.
- To understand the discipline in global and national context.

METHODOLOGY:

- Lectures and presentations based on field observations, surveys, web search and library studies.

CONTENTS:

Psychology: Human being as living systems, human behaviour and the built environment,

- Definition and need & Schools of psychology, Current Perspectives & trends in Psychology,
- Biological bases of behaviour: sensory systems, nervous system, motivation & emotion, Stress and anxiety, Consciousness and its altered states, Personality and Individual Differences
- Cognition: Cognitive processes, Sensation and perception, theories of visual perception (gestalt),
- Learning and behaviour, Thinking and language; Intelligence, Sensitivity, Creativity, Logic & Reasoning,
- Psychology in Design & Environment (man-nature interaction, personal space concept, pollution redction)

Sociology: Man, nature and society; social, religious, political, cultural structure and their impact.

- Origin and Growth of Cities, rural-Urban Dynamics and resultant migration, Impact of industrialization on traditional society, modernization, Urbanisation & Urbanism, rural-urban differences
- Classical and Contemporary theories of Sociology, European and Chicago school of thought
- Society as a total system of relationships between people, Social stratification, Diversity in Indian Society
- Traditional pattern and trends of change in community; Urban problems and issues,
- Technology, Globalization and changing socio-economic scenario, Sociology & Design

Economics: Theory of Demand & supply, Micro & Macro Economies, Economic systems , G.D.P, G.N.P, F.D.I, Migration, Division of Labour, Economies of Scale, Urban & Rural Economies, Cost Benefit Analysis, Feasibility, Viability

- Economic development of the country, dynamics of infrastructure development and the role of government agencies; financing and institutions associated with housing and infrastructure development
- Real Estate dynamics; Real Estate & Cost Index; Poverty line, real estate & nature of shelter of population
- Socio-economic structure of the country, global and local socio-economic processes and policies
- Implications of Globalisation on the Third World Economies, Global and National Organizations

MAR 203

Digital applications in Architecture

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	2	50	-	50	100	-	4

OBJECTIVE:

- To understand the digital technology and the way it is transforming our built environment.

METHODOLOGY:

Lectures and presentations based on field observations, surveys, web search and library studies.

CONTENTS:**Digital Applications**

- Introduction, History and Scope of Digital Technologies in Architecture
- **Digital applications used in creating a built environment:** *Applications used from Conception to construction of a built environment at micro and macro level:*
 - **Presentation:** Raster & vector graphics, Colour models, file formats and their usage, presentation techniques in Architectural graphics and Animations.
 - **Visualization as a tool for design:** Visualization of complex forms, Digital Architecture, Parametric designing, Programming and scripting as tool for design.
 - **Designing, Drawing & detailing:** Applications used for design processes and considerations, Softwares used in AEC industry: CAD CAM & BIM applications.
 - **Digital Fabrication & Construction:** Applications and fabrication techniques.
 - **Management:** Applications used in conjunction with digital drawing information.
- **Digital applications used in Planning:** Remote sensing, Transport simulation applications etc
- **Digital technologies transforming our built environment:**
 - Building automation & Intelligent building concepts
 - Energy modelling applications
- **Recent trends:** Contemporary examples, role and need of Digital applications in transforming our society and built environment.

MAR 204: Energy Simulation

CLASSES/ WEEK		MARKS				EXAM HOURS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>	
2	2	50	50	-	100	3

OBJECTIVE:

- To inform the students about the importance of energy efficiency and its conservation.
- To learn the basic techniques and processes involved in Energy Efficiency and Energy Conservation through various techniques. The study and application of various softwares involved in the process.

METHODOLOGY:

- The methodology of imparting information should be lectures and presentations citing examples and case studies.

CONTENTS:

- **Introduction**
 - LEED
 - Benefits and Advantages
 - Incentive Programs
 - Certification
 - Leed Version
 - Professional Accreditation
- **Green Building Concept**
 - Indian Green Building Council
 - Concepts of Green Building
 - Case Study of Green Buildings
 - Energy and Resource saving through Green Buildings
 - Role of TERI
- **Energy Conservation Building code ECBC**
 - Role of Bureau of Energy Efficiency BEE in controlling Energy Scenario in India
 - Application of ECBC in Indian Buildings
 - Analysis of saving of Energy by the application of ECBC
- **Application of Softwares**
 - Introduction of Important Softwares in Energy Modelling of Buildings
 - Application of Visual DOE in Modelling any one building

MAR 225: HVAC Services

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
4	2	75	75	-	150	3	6

OBJECTIVE:

- To understand the basic and advanced principles of HVAC Services in buildings and at Site level. that would be pertinent to HVAC in Buildings.

METHODOLOGY:

- The methodology of imparting information should be lectures and presentations citing examples, site visits, market analysis and case studies.

CONTENTS:

- **HVAC Services**
 - **Basics of Air Conditioning**
Basic working principle of an airconditioning system- vapour compression and vapour absorpion cycles and their applications, components, working etc.
 - **HVAC Systems & Components**
Classification between centralized & decentralized HVAC systems, air-cooled & water cooled systems. Different types of systems under each category, their working, components involved, installation guidelines, cost, advantages & disadvantages in comparison to others etc.
 - **Thermal Comfort Principles**
Understanding of thermal comfort in a building and factors involved. Introduction to psychometric chart. HVAC Components involved in Thermal Comfort and Indoor Air QualityASHRAE Standards and Guidelines
 - **HVAC System Design**
HVAC system design considerations, components of cooling/Heating load, methods for calculation of cooling/ heating load, understanding & calculation of cooling load for a small building by any one of the prevalent methods. HVAC system selection criteria, design of system components based on cooling load, selection criterion, ASHRAE/ ISHRAE guidelines, market survey & case studies (min. one building).

- **Advanced HVAC systems**
Factors Affecting Performance and Efficiency of Refrigeration Plants, Heating/ cooling load reduction technologies (active/passive), sustainable HVAC technologies.
 - **Integration of HVAC Services with other building services.**
Intelligent controls and system integration.
 - Case Study of Any One Building
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- **INDICATIVE READING LIST AND REFERENCES:**

- ASHRAE HANDBOOK 2018,
- HVAC Design Sourcebook 1st Edition by W. Larsen Angel (2011)
- Comprehensive HVAC Design: A Handbook on Practical Approach to Air Conditioning, Heating and Ventilation System, by N.C. Gupta

MAR 226: Studio-I

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	4	75	-	75	150	-	6

OBJECTIVE:

- To understand the basic and advance principles of Building Services that would be pertinent to simple and advance design building services.

METHODOLOGY:

- The methodology of imparting information should be live case studies, field visits and study of building codes

CONTENTS:

- **Studio based on HVAC Services**
 1. The students will be required to do Studio exercises based on the theory taught in HVAC Services.
 2. The calculation of heat loads and selection of equipments (lower side only), shall be taught in the studio class.
 3. Also the information regarding the equipments (higher side) shall be given.
 4. The live case studies, field visits and sound knowledge and application of building codes with reference to HVAC services. At the end of the semester the students must understand the design aspect of HVAC services.

- **INDICATIVE READING LIST AND REFERENCES:**

- ASHRAE HANDBOOK 2018,
- HVAC Design Sourcebook 1st Edition by W. Larsen Angel (2011)

MAR 227(BS): Dissertation-II (BS)

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	-	50	100	-	4

DISSERTATION-II**OBJECTIVE:**

- To understand the basic principles of Building Services that would be pertinent to simple and advance design building services.
- The idea is to present a hypothesis for anyone building service design and to prove its validity through cases studies and designing of a multistoried commercial, institutional or residential building.
- Also the building service designed should be automated, so that it supports the idea of smart buildings.

METHODOLOGY:

- The methodology of imparting information should be studio exercises and presentations based on the theory taught in the theory subjects.
- The basic understanding and application of major building services which will act as foundation for the advance form of building services which will come in subsequent semesters.
- Students have to submit two synopses. One of the synopsis would be approved, that is going to be furthered for research.
- Final submission would be a report including the final synopsis.
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MAR 321: Electrical Services

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

ELECTRICAL SERVICES**LEARNING APPROACH:**

- Lectures and Seminars
- Workshop/Case Studies
- Tutorials
- In class assessments

OBJECTIVES:

- To provide students with thorough knowledge and critical appreciation of electrical installation design and operation in modern, large high rise buildings and complexes.

METHODOLOGY

- The emphasis will be on design methodology for safe and economic system performance, and the troubleshooting of operational problems. A critical review of current practices with a view to developing a total systems design approach, with integration and co-ordination aspects will be emphasized. The subject will place emphasis on efficient supply, distribution and utilizations of electrical energy in buildings.

CONTENTS

- **HV supply and distribution in buildings:** HV switchgear, distribution, control, protection schemes, HV and LV co-ordinate protection.
- **Review of design & operating objectives and criteria:** electricity supply ordinance, rules, codes and regulations affecting supply and utilization of electricity.
- **Electric safety and risk assessments:** nature and mechanisms of electric shock, assessing electric shock risk, isolation, earthing and bonding principles and practices.
- **Earthing for lightning protection, functional purposes and safety:** integrated scheme for high rise buildings. Design of earth electrode systems. Integration with building structure.
- **Fault calculations for LV systems:** IEC standard methods. Data for calculations.

- **Over current protection** for large plant, cabling systems, motor drives, etc. Sizing electrical conductors. Earth fault protection. Selection of equipment.
 - **Standby generation.** Dynamic analysis of engine/generator. Load profiles, regenerative power. Generator selection, protection. Reliability analysis. Requirements for fire services systems. Co-generation schemes, economics.
 - **Uninterruptible power supplies:** UPS dynamics, load profiles, battery sizing, protection, failure modes, MTBF. Generator/UPS/Load transient analysis. Earthing UPS systems.
 - **Motor drives:** Fan, pump, chiller, etc. System characteristics, load and supply variations, integrated control and protection schemes. Inverter drives. Starting dynamics, fault, transient and harmonic analysis. System energy analysis.
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- **INDICATIVE READING LIST AND REFERENCES:**

- BS/IEC/VDE standards, publications and codes
- EMSD & FSD code of practice
- Engineering Council -Power System Protection Vols 1 &2
- ERA Technology -Research Reports Extracts (compilations)
- GEC -Protective Relays Application Guide
- Handbook on IEE Wiring Regulations -Trevor Marks (current edition)
- IEEE Transactions on PAS and IA (selected papers)
- IEE Regulations (current edition)
- Tagg -Design of Earthing Systems

MAR 322: Fire Services

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	2	50	50	-	100	3	4

FIRE SERVICES**LEARNING APPROACH:**

- Lectures and Seminars
- Workshop/Case Studies
- Tutorials will be conducted with aids of film shows, demonstrations, discussions on published papers and problem solving based on examination type questions.

OBJECTIVES:

- To equip the students with an in-depth and up-to-date knowledge of fire engineering systems associated with the building services industry, based on a rational and critical analysis of the systems.

METHODOLOGY

- The emphasis will be on design methodology for safe and economic system performance, and the troubleshooting of operational problems. A critical review of current practices with a view to developing a total systems design approach, with integration and co-ordination aspects will be emphasized.

CONTENTS

- **Basic engineering science of water-based fire engineering systems:** Dynamics of jets and sprays for water; Fire extinction theories of water; Properties of high, medium and low expansion foams; Fire extinction theories of foam.
- **Water-based fire engineering systems:** A critical analysis of various codes for the application, design, installation, operation, and maintenance of fire hydrant/hosereel systems, i.e. Indian Fire Services Department Codes.
- **Pedestal fire hydrant systems;** Sprinkler systems (Loss Prevention Council LPC/National Fire Protection Association NFPA Rules); Thermal responses of sprinkler heads; Water spray/deluge systems (NFPA Code); Drencher systems.

- **Total flooding gas protection systems:** A critical analysis of the codes for the application, design, installation, Halon substitutes systems, CO2 systems and dry powder systems; Computer programmes for system design.
 - **Basic engineering science of gas systems;** Dynamics of jets and sprays for gases; Fire extinction theories of gaseous extinguishing agents and dry powders.
 - **Smoke management systems:** Legal and insurance requirements of smoke extraction, and staircase pressurization, critical review of the principles, equations, design guides and codes of practice etc.; Computer simulation.
 - **Fire safety controls in HVAC systems:** Fire detection systems, fire communication systems and false alarm; System control, operation and maintenance of fire engineering systems; System reliability.
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- **INDICATIVE READING LIST AND REFERENCES:**

- Chow W.K., On the Sprinkler Tank Size and Fast Response Sprinkler Head, International Journal on Engineering Performance-Based Fire Codes, Vol. 2, No. 4, p. 124-126 (2000).
- Chow W.K., Fong N.K. and Ho C.C., Analysis of Unwanted Fire Alarm: Case Study, ASCE Journal of Architectural Engineering, Vol. 5, No. 2, p. 62-65 (1999).
- Chow W.K., Smoke Control for Retail Shops with Cabin Design, ASHRAE Transactions, Vol. 110, Part 2, p.417-423 (2004)
- Fire Protection Handbook, 19Ed., National Fire Protection Association, Quincy, MA, USA (2003)
- **NFPA 13 Handbook (2019)**

MAR 323: Lighting Services

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

LIGHTING SERVICES**LEARNING APPROACH:**

- Lectures and Seminars
- Workshop/Case Studies
- Tutorials
- In class assessments

OBJECTIVE:

- To provide the students with up-to-date knowledge of lighting technologies and practice. Photometrics of lamps and luminaries as well as characteristics of lamp and ballast systems are examined. To provide students with up-to-date knowledge of lighting technologies and practice. Photometrics of lamps and luminaries as well as characteristics of lamp and ballast systems are examined. Lighting objectives of various types of buildings and outdoor spaces are identified and various design techniques and calculations are examined. The balance between performance, comfort and energy consumption are also examined. Importance of lighting in relation to health, safety, and well-being, economics and energy conservation, and human productivity and creativity are discussed.

METHODOLOGY:

- In addition to lectures and guided reading, students are required to do an evaluation of a lighting scheme or a case study or a literature review and present their work in seminars and/or reports.

CONTENTS:

- **Photometry and colorimetry:** Photometric quantities, standards and measurements. Colorimetric quantities and systems. Production and processing of photometric data.
- **Lighting equipment and systems:** Incandescent lamps. Discharge lamps. Fluorescent lamps. Luminaries and control gear. Conventional and electronic ballasts. Lamp and ballast as a system. Lighting control systems. New light sources and emerging lighting systems.

- **Lighting calculations:** Direct luminance due to point, line and area sources. Inter-reflections. Lumen method. Calculation of utilization factors. Point-by-point and flux transfer methods.
 - **Daylighting:** Daylighting benefits. Daylight availability. Sky models. Design techniques and calculations. Daylight-linked control systems.
 - **Human and environmental factors:** Vision and human factors. Visual performance and its assessment. Lighting and comfort, glare. Non-visual effects of light. Lighting quality.
 - **Lighting design:** Design objectives and criteria. Choices of lighting system, lamp and luminaires. Integration of electric light and daylight. Energy conservation. Maintenance of lighting systems. Cost analysis. Lighting economics. Lighting energy code.
 - **Computer aided lighting design:** Electronic transfer of photometric data. Overview of features, applications and limitations of lighting design packages. Future trends.
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- **INDICATIVE READING LIST AND REFERENCES:**

- CIBSE Code for Lighting (2002)
- Coaton, J.R. and Marsden, A.M. *Lamps and Lighting*. 4Ed. Arnold (1997)
- IESNA Lighting Handbook (2000)
- ISO 8995: 2002 Lighting of indoor work places.
- Selected CIE Publications. Selected papers in the following journals: Lighting Research and Technology, Journal of the Illuminating Engineering Society, Built Environment, Energy and Buildings.
- Simons, R.H. and Bean, A.R. *Lighting Engineering – Applied Calculations*. Architectural Press (2001)

MAR 324: Architectural Building Acoustics

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

ARCHITECTURAL BUILDING ACOUSTICS**LEARNING APPROACH:**

- Lectures and Seminars
- Workshop/Case Studies
- Tutorials
- In class assessments

OBJECTIVE:

- To extend knowledge of students on acoustics, noise and vibration control to acoustical design of special rooms and the practices of noise and vibration control, and to enable graduates to become specialists of their design office.
- To train students in greater breadth and depth to achieve a satisfactory acoustical environment.
- The subject will start with a discussion on indoor noise and vibration sources and their effects on human beings.
- Acoustic design needs of various indoor environments will be identified. Noise and vibration control methods will be discussed and examined.
- Instrumentation, measurement techniques and acoustic application software will be examined and discussed. The use of equipment will be demonstrated.

METHODOLOGY:

- Seminars will be used for the introduction of concepts and fundamentals of the subjects. Tutorials will be conducted to supplement the lectures for the application and better understanding of complex engineering theories. Students are required to read and discuss course materials and relevant publications at seminars and to prepare alternative solutions to problem.

CONTENTS:

- **Acoustic fundamentals:** Fundamental properties of sound and waves, sound sources, sound field in enclosures, sound propagation and transmission inside buildings, external impact, room acoustics, sound generation and transmission in air ducts. Effects of noise on human beings.
- **Interaction of sound and people: The different phenomenon with which sound interacts with people in different acoustically enhanced buildings. Interacting phenomenon's affecting the design of these buildings.**
- **Acoustic design and planning:** Acoustic design requirements for auditorium, lecture theatres, plant rooms etc. Requirements for speech and music: loudness, directional and special impression, reverberation, echo, clarify and etc., silencers, active noise control. Prediction methods for building acoustics and flow generated noise.
- **Architectural Acoustics: Room acoustics, urban soundscape, sound isolation.**
- **Environmental impact and local legislation:** Noise control ordinance, product noise control ordinance, environmental administration, environmental impact assessment, practical noise control strategy.
- **Vibration:** Fundamentals of vibration, vibration sources and their control, acoustically driven vibration, vibration transmission, flow-induced vibration, statistical energy method and modal analysis.
- **Problem investigations:** Instrumentation, noise and vibration measurement and data analysis techniques, signal processing, problem identification and assessment, software packages.

- **INDICATIVE READING LIST AND REFERENCES:**

- Acoustic Design of Concert Halls and Theatres. V. L. Jordon (1980).
- Acoustic Noise Measurement. J. R. Hassall (1979).
- Active Control of Sound. P. A. Nelson and S. J. Eillott (1993).
- An Environmental Assessment for Existing Office Buildings. BRE (1993).
- An Environmental Assessment for New Office Design. BRE (1993).
- Applied Acoustics Journal.
- BS and ISO standards.
- Community Noise Rating. T. J. Schultz (1982).
- Concert Halls and Theatres: How they sound. L. L. Beranek (1996).
- Effects of Noise on Man. K. D. Kryter (1985).

MAR 325: Intelligent Buildings

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

INTELLIGENT BUILDINGS**LEARNING APPROACH:**

- Lectures and Seminars
- Workshop/Case Studies
- Tutorials
- In class assessments, technical assignments

OBJECTIVE:

- To provide the students with enhanced knowledge of advanced intelligent building technologies, system configuration, system operation and control.

The emphasis will be on use of system integration, application of technologies and the operation performances. A critical review of current practices with a view to developing a total intelligent building system, with integration and co-ordination aspects will be emphasized.

METHODOLOGY:

- In addition to lectures and guided reading, students are required to do an evaluation of an advance intelligent building technology scheme or a case study or a literature review and present their work in seminars and/or reports.

CONTENTS:

- **Intelligent Buildings:** concepts, definitions of intelligent buildings, intelligent architecture and structure, evolution of intelligent buildings, IB assessment criteria.
- **Building Management System (BMS):** binary data, digital controller, input and output units, sensors and actuators; architecture and configuration of BMS, BMS outstation and central station, programming environment and platform, monitoring interface and development platform, building energy management functions.
- **Local Area Network (LAN) and BMS Communication Standards:** Local Area Network (LAN), protocol standards and OSI model, medium-access schemes, different BMS network configurations, gateway and interoperability, BACnet, integration at management level.

- **Applications of Internet Technologies in BMS:** Internet and Internet protocols, TCP/IP, Internet LAN vs WAN, use of Internet technologies at different levels, BACnet/IP, Convergence networks and total integration.
 - **Advanced Direct Digital Control:** closed control loops, control loop stability, PID control and tuning of PID; auto-tuning, self-tuning, adaptive control.
 - **HVAC System Control and Optimization:** control of CAV and VAV systems, outdoor ventilation control and optimization, optimal control of air-side systems; chiller performance and optimal control of central chilling systems.
 - **Other Building Automation Subsystems:** building security systems; access control, cards access control and biometric access control; lighting control systems; fire detection systems; lift control systems.
 - **General layout of anyone smart building, depicting the connections of the automation system with the building management systems.**
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- **INDICATIVE READING LIST AND REFERENCES:**

- B Atkin (1988) Intelligent Building, John Wiley & Sons.G J Levermore.
- Building Energy Management Systems, E&FN Spon.Leszek Reiss (1987) IESNA Lighting Handbook (2000)
- Introduction To Local Area Networks with Microcomputer Experiments, Prentice Hall Inc.S.W. Wang (2003) Selected CIE Publications. Selected papers in the following journals: Lighting Research and Technology, Journal of the Illuminating Engineering Society, Built Environment, Energy and Buildings.
- 1992Intelligent Building and Building Automation, The Hong Kong Polytechnic University

MAR 326: Studio-II

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	2	50	-	50	100	-	4

STUDIO-II**LEARNING APPROACH:**

- Workshop/Case Studies
- Tutorials
- In class assessments
- Understanding and designing of the building services

OBJECTIVE:

- To provide the students with enhanced knowledge of advanced building services. Understanding and designing of building services with the help of consultants. Live examples may be taken so that the students are able to learn of the latest in building services design.

METHODOLOGY:

- The expert lectures from the leading building services consultants and their continuous guidance through the semester.

CONTENTS:

- **Electrical Services.:** the calculation of the load of the building, and its estimated load taking into account all the safety factors, design of the substation and layout of wiring system.
- **Fire Services: Accounting for the fire load in the electrical load. The fire loads would include smoke detectors, alarms, Public addressal system.**
- **Lighting Services: Also considering the lighting loads, depending upon the selection of lamps. And the design of the lighting layout.**
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MAR 327: Dissertation-III

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	0	50	-	50	-	3	4

DISSERTATION-III**OBJECTIVE:**

- To understand the basic and advance principles of Building Services that would be pertinent to simple and advance design building services.
- The idea is to present a hypothesis for anyone building service design and to prove its validity through cases studies and designing of a multistoried commercial, institutional or residential building.
- The building service which is to be designed, has to be in detail; which includes the calculations, basic assumptions, system/equipment selection.
- Also the building service designed should be automated, so that it supports the idea of smart buildings.
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METHODOLOGY:

- The methodology of imparting information should be studio exercises and presentations based on the theory taught in the theory subjects.
- Students have to submit two synopses. One of the synopsis would be approved, that is going to be furthered for research.
- Final submission would be a report including the final synopsis.
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MAR 401:**Project Management**

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	3	4

OBJECTIVE

- The intent of course is to disseminate about the application of project management in construction industry during the different phases of project.

METHODOLOGY

- Lectures and Presentations to sensitize the students.
- Students to make study of project management procedures followed by organizations.
- Case Studies to be taken up by students (in consultation with the concerned teacher) for understanding through critical appreciation.

SUBMISSION

- Assessment shall be done on study reports and presentations submitted by students.

CONTENTS

- Project life cycle - processes from inception to post construction
- Applications of cost benefit analysis, Feasibility Report, value engineering etc.
- Project Planning
- Project Monitoring and control
- Application of project management processes (i.e., communication and integration, scope, time, cost, health, safety and environment, risk management, human resource management etc.)
- Project Procurement and Management
- Study of procurement guidelines of international institutions such as FIDIC, WORLD BANK, ADB etc.
- Project Management - Organisation, Roles and Responsibility

MAR 422: Thesis (BS)

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
2	14	200	-	200	400	-	16

THESIS (BS)**OBJECTIVE:**

- To understand the basic and advance principles of Building Services that would be pertinent to simple and advance design building services. The students must be able to design the building services at this level. They may take any one of the services and design for any one of the contemporary building.
- The idea is to present a hypothesis for anyone building service design and to prove its validity through cases studies and designing of a multistoried commercial, institutional or residential building.
- Also the building service designed should be automated, so that it supports the idea of smart buildings.

METHODOLOGY:

- The students must submit three synopses for approval. One of these will be approved. The progress will be monitored regularly in various stages.
- The final submission would be in the form of report, which would include the final synopsis.

MAR 423: Dissertation-IV (BS)

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	<i>TOT</i>		
1	7	100	-	100	200	-	8

DISSERTATION-IV(BS)**OBJECTIVE:**

- To understand the basic and advance principles of Building Services that would be pertinent to simple and advance design building services.
- The student should present a hypothesis, which must be validated/proved null through their design.
- In this semester the student might take up an auxiliary building service for the same building which they have taken in the thesis.

METHODOLOGY:

- The methodology of imparting information should be studio exercises and presentations based on the theory taught in the theory subjects.
- Students have to submit two synopses. One of the synopsis would be approved, that is going to be furthered for research.
- Final submission would be a report including the final synopsis.

MAR 424: Plumbing and Solar Water Heating

CLASSES/ WEEK		MARKS				EXAM HOURS	CREDITS
<i>L</i>	<i>ST</i>	<i>IA</i>	<i>WR</i>	<i>VV</i>	TOT		
2	2	50	50	-	100	-	4

PLUMBING AND SOLAR WATER HEATING SERVICES**LEARNING APPROACH:**

- Lectures and Seminars
- Workshop/Case Studies
- Tutorials
- In class assessments

OBJECTIVES:

- To provide students with thorough knowledge and critical appreciation of plumbing installation design and operation in modern, large high-rise buildings and complexes and about solar energy technologies.

METHODOLOGY

- The emphasis will be on design methodology for safe and economic system performance, and the troubleshooting of operational problems. A critical review of current practices with a view to developing a total systems design approach, with integration and co-ordination aspects will be emphasized. The subject will place emphasis on efficient supply, distribution and utilizations of plumbing and learning the usages of solar services.

CONTENTS

- **Water Supply and Drainage:** Water Supply, drainage and sanitation as per National Building Code (Part 9). Water supply and drainage of a building. Leakages and seepages.
- **Green Building Parameters for Plumbing Design:** Green building parameters. Methods of harvesting rainwater. Conserving water for making sustainable and resilient conditions. GRIHA and TERI standards.

- **Quantity of Sanitary Sewage:** Types. Infiltration, Quantity estimation for future and effect of population growth on per capita sewage production. Variation in quantity of sewage (hourly, seasonal, monthly).
- **Quantity of Storm Water Sewage:** Storm water quantity on basis of amount & intensity of rainfall, catchment area. Usage of rainwater. Estimation for maximum runoff and area time graph.
- **Design of Sewers:** Sanitary sewers. Factor of Safety. Storm water sewage. Self-cleaning velocity. Calculation of sewer sizes (Crimp & Burge's Formula, Hazen William Formula). Velocity of flow, Limiting Velocity. Planning & design of sewage system.
- **Treatment of Waste Water and Disposal:** Ways to treat water. Different degrees of treatment (Preliminary, Primary, Secondary, Tertiary, Advanced). Disposal of Sewage after treatment, dilution and irrigation. Sewage sickness and prevention.
- **Solar Energy:** Study of Photovoltaic generation of electricity, and generation of electricity using solar thermal collectors. Elements of designing the photovoltaic panel and the study of electricity generation through them. Advantages and disadvantages over conventional electricity generation. Passive solar techniques. Government policies and subsidies. Calculation for Solar Roofs, electricity generation and solar cities. Wind energy production, utility and constraints.

INDICATIVE READING LIST AND REFERENCES:

- National Building Code
- GRIHA Guidelines