School of Architecture, REVA University

MASTERS IN ENVIRONMENTAL ARCHITECTURE

(2 years Full time Post Graduate Programme)

HANDBOOK

Batch 2023-2025

Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said ‘A University should be a place of light, of liberty and of learning’. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Dr. M. Dhanamjaya
Vice Chancellor, REVA University

DIRECTOR MESSAGE

The School of Architecture, REVA University has been delivering innovative, contemporary and practice oriented undergraduate education since the year 2015. We are ranked 4th Pan India in the GHRDC ranking for B. Arch in the super excellence category in the year 2023. The school also offers a post graduate degree in Environmental architecture (M.Arch). The Masters' degree offers flexibility for practicing professionals and equips students with essential skills and theory to design, develop and implement environment friendly solutions for new and retrofitted buildings. The program allows students to delve into the complexities of creating sustainable futures and advance their knowledge and technical skills. Our renowned team of industry partners have curated a curriculum that bridges the widening skills gap across industry and academia in energy efficient and sustainable building practice. The identified industry partners actively engage in delivering course modules, and spend their time giving valuable inputs as jurors and reviewers for the studio projects. Courses included in the programme aim to enhance the abilities to professionally communicate complex sustainability strategies and engage effectively within interdisciplinary teams to drive project outcomes and improve sustainability practice. Students will graduate with specialist knowledge of sustainable building design and technologies.

The school also offers Doctoral research program with scholars researching on diverse topics of interest in architecture and planning. Surely, the new program in Environmental architecture will carve out a unique niche for REVA University School of Architecture to pave the way to be leaders in architecture education in India.

Vidya Srikanth

Director, School of Architecture

About REVA University

REVA University is a private state University located in Bangalore, Karnataka. The Reva Group of Educational Institutions was established in 2002, managed by Rukmini Educational Charitable Trust. REVA University was established in 2004 as an educational venture by the Divyasree Developers. REVA University is built on a campus of about 45 acres and is a technical education center approved by the All India Council for Technical Education (AICTE).

Vision & Mission

"REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards".

The mission of the university is:

1. To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
2. To provide a student-centric learning environment through innovative pedagogy and education reforms
3. To encourage research and entrepreneurship through collaborations and extension activities
4. To promote industry-institute partnerships and share knowledge for innovation and development
5. To organize society development programs for knowledge enhancement in thrust areas
6. To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

Every University aspires to inspire students and scholars to achieve excellence; it is more or less the driving force of a successful institution. A University goes beyond conformity when its approach to inspiring students changes with the time. The norms, requisites and standards of educating the leaders of tomorrow are changing dynamically and it is imperative for a university to keep up with the times to ensure a radical difference in the landscape of education.

On that Principle, the Core Values and Purpose of REVA University is to:

- Attain excellence in different disciplines by creating, preserving and disseminating knowledge to all aspiring students.
- Draw inspiration from the University's ethos and develop within its members a sense of accountability towards their community, society and the nation at large.
- Accept the challenges globalization and changing times throw at us to offer high quality education and developmental services in a competitive manner.
- Provide every opportunity to the University's key constituents–its faculty, staff, students and the community–to excel in their domain of expertise and contribute to every task with sincerity.
- Transition from the teacher–centric focus to the learner-centric approach in imparting knowledge.

Masters in Environmental Architecture
Offered by School of Architecture, REVA University

The School of Architecture, REVA University proposes to launch a 2 year Masters in Environmental Architecture degree Programme from July 2021. The programme is designed as a niche offering targeted at young architecture professionals who are passionate about environment friendly architecture and sustainable urban futures. The programme will offer students an eclectic mix of theory and well as practice oriented courses drawing on the latest technological advances and analytical tools for environmental analysis, simulation and building design. Inclusion of latest cutting edge softwares for energy simulation and design is the highlight of the course. The programme has an inbuilt component of Industry based internship which will help the students orient themselves towards the real life projects and get a head start in their career. The programme will be accredited by Council of Architecture, New Delhi.

Program Educational Objectives (PEOs)

The programme educational objectives of the Masters in Environmental Architecture are to prepare graduates who:

PEO 1: Demonstrate innovative ideas to development a self-sufficient building design of multidisciplinary fields towards the environment.

PEO 2: Enhance the scope of advanced sustainable design techniques and technologies.

PEO 3: Demonstrate a holistic understanding of ecological design which respond to the emerging climatic challenges, safety, sustainability.

PEO 4: Demonstrate the ability to lead in education, research, and specialized professional abilities in multidisciplinary fields.

Program outcomes (POS):

Upon successful completion of the M.Arch programme, graduates shall be able to:

a. Assimilate the fundamental knowledge of sustainability issues and environmental impact of the built environment.
b. Apply innovative and environmentally sensitive design solutions in the global context

c. Demonstrate an understanding of Integration of resource efficient building and intelligent technologies
d. Demonstrate the ability to deliver a project using Digital tools and simulation software.
e. Demonstrate an understanding of Day lighting & Ventilation, Thermal comfort and Indoor air quality in buildings.
f. Gain familiarity with environmental economics, environmental Laws, Green Building codes and standards.
g. Perform all professional responsibilities independently and as a team member with leadership skills and ethical values
h. Develop the ability to become a lifelong learner through advanced (offline/online) specializations and participate in conferences/ seminars to acquire and disseminate knowledge.

Unique Offerings by REVA for this particular program

- Dynamic curriculum helmed by an Independent Board of Studies that encourages innovations in pedagogy including course delivery, monitoring and evaluation.
- REVA University evaluates students through Choice Based Credit System (CBCS) and Continuous Assessment and Grading Pattern (CAGP) of education. The CBCS and CAGP patterns of education have been introduced to enable students to opt for subjects of their choice in addition to the core subjects of study and prepare them with required skills.
- Provides ample opportunities for students to earn more credits and thereby acquire additional Proficiency Certificates and Diplomas.
- Cross-disciplinary open electives and concurrent learning.
- Emphasis on research and Pragmatic learning
- Hands-on learning through Skill development certification courses and workshops.
- Study tours and documentation at National and International locations.
- Diverse Faculty- Competent full-time faculty from different geographies, specializing in varied allied fields ensure diversity in the educational philosophies and pedagogical approach towards imparting knowledge. Renowned professionals from the field of architecture and urban planning frequent the school to impart practical knowledge to all aspiring architects.
- World-class infrastructure including Climatology and Services labs, Cutting-edge building planning and simulation software, Dedicated art and exhibition room
- MoU with CSE (Centre for Science and Environment) with emphasis on knowledge sharing, training and research partnership in the field of environmental issues and

technologies for a sustainable future. The Master's Programme will draw heavily from this unique partnership.

- International collaborations- MoU with ETSAB - Barcelona and UCOL - New Zealand
- Centre for Integrated Research in Architecture (CIRA), School of Architecture- The Centre for Integrated Research in Architecture (CIRA) is established to fulfil the need of the construction industry research and knowledge advancement, professional practice, and experience through inter-institutional collaboration and information exchange between the University and Industries.

Board of studies

Sn	Name	Address	Contact No.	Email	
1	Prof. Vidya Srikanth	Director, School of Architecture, REVA University	9972256670	dir.arch@reva.edu.in	Chairperson
2	M. Selvarasu	Managing Director, LEAD Consultancy	9611344077	selvarasu@lcsind.org	Industry expert
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6	Ar. Kiruthika S.	Associate Professor, School of Architecture, REVA University.	9710766209	kiruthikaselvi.k@reva.edu.in	Industry & academia

Experts Identified for Advisory Board

1. Mr. M. Selvarasu, Managing Director, LEAD Consultancy and Engineering Services (India) Private Ltd.
2. Mr. S. Karthikeyan, Counsellor-Energy, Confederation of Indian Industry, Bangalore
3. Mr. Kiriti Sahoo, Area Convener, Sustainable Buildings (SRC), TERI, Bangalore
4. Mr. Harsha Sridhar, Principal Architect, Initiatives for Green habitats, Bangalore
5. Mr. Guru Prasad Pandit, Sustainability Consultant, Edge Environment, Sydney

Regulations – M. Arch. (Environmental Architecture) Degree Program

Batch 2023-25

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – M Arch (Environmental Architecture), Degree Program 2023-25 Batch subject to amendments from time to time by the Academic Council on the recommendation of respective Board of Studies and approval of Board of Management.**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Program:

These regulations cover the following M Arch., Degree programs of REVA University offered during 2023-25: **M Arch (Full Time) in Environmental Architecture**

3. Duration and Medium of Instructions:

3.1 **Duration:** The duration of the M. Arch. degree program shall be **TWO years** comprising of **FOUR** Semesters. A candidate can avail a maximum of 8 semesters - 4 years as per double duration norm, in one stretch to complete M. Arch. degree.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 **Course: "Course" means a subject, either theory or practical or both, listed under a program;** Example: "Environmental Architectural design studio" in the M Arch. program is an example of a course to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	**Lecture**
P	**Practical**
D	**Design**

Where:

- **L** stands for **Lecture** session consisting of classroom instruction.
- **P** stands for session consisting of Lab/ Seminar/ Practice participatory discussion self-study /desk work /brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.
- **D** stands for Design Studio Session and it consists of Hands-on Experience/ Field Studies/ Case Studies that equip students to acquire the much-required skill component.

4.2 **Classification of Courses**

Courses offered are classified as: Professional Core Courses, Open Elective Courses, Project work/Dissertation

(1) **Professional Core (PC) Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

(2) **Building Sciences and Applied Engineering (BS and AE) Course:** A course which informs the Professional core and should compulsorily be studied.

(3) **Elective Course:** Generally, a course which can be chosen from a pool of courses and are of two types:

(i) **Professional Elective (PE)** which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope

(ii) **Open Elective (OE)** which enables an exposure to some other discipline or subject or domain ornurtures the candidate's proficiency or skill

(4) **Employability Enhancement Courses (EEC)** which may be of two kinds: Employability Enhancement Compulsory Courses (EECC) and Skill Enhancement Courses (SEC)

4.2.1 **Thesis:**

A thesis is a special course involving application of knowledge in solving/ analyzing and exploring a real-life situation/ difficult problems to solve multivariable or complex engineering problems.

5. Eligibility for Admission:

The candidate with a minimum of 50% marks in aggregate in a Bachelor of Architecture degree course or equivalent courses recognized by the Council of Architecture shall be admitted to the postgraduate course in architecture.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for final examination, evaluation and announcement of results

6.3 The credit hours defined as below:

In terms of credits, every ***one-hour session of L amounts to 1 credit per Semester*** *and a minimum of* ***two-hour session of P amounts to 1 credit per Semester, 1 hour of Design session amounts to 1 ½ credit*** *over a period of one Semester of 16 weeks for teaching-learning process.*

The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course.

7. Credit and Credit Distributions:

7.1 A candidate has to earn 80 credits for successful completion of M. Arch. (Environmental Architecture) degree with a distribution of credits for different courses as prescribed by the University.

7.2 A candidate can enroll for a maximum of 30 credits per Semester. However, he/ she may not successfully earn a maximum of 30 credits per semester. This maximum of 24 credits does not include the credits of courses carried forward by a candidate.

7.3 Only such full-time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 80 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8. Assessment

a) Each course is assessed for a total weight of 100%. Out of the total 100% weight; 50% weight is for Continuous Internal Assessment (CIA or IA) and the remaining 50% for the Semester End Examination (SEE). This applicable for theory, laboratory, workshop, studio and any such courses

b) The tests and assignments are conducted as per the semester academic calendar provided by the University

The details as given in the table:

Component	*Description*	*Conduction*	*Weight Percentage*
C1	*Test-1: IA1*	*6th week from the starting date of semester*	*15*
	1 Assignment + 1 seminar	*7th week*	*05 + 05*
C2	*Test-2: IA2*	*12th week from the starting date of semester*	*15*
	1 Assignment + 1 seminar	*13 th week*	*05 + 05*
C3	*SEE including practical*	*between 17th Week-20th Week*	*50*
Results to be Announced			*By the end of 21st Week*

Each test must be conducted for a minimum duration of 60 minutes, setting the test question paper for a maximum of 30 marks. The final examination must be conducted for duration of 3 hours and the question paper must be set for a maximum of 100 marks. In case of Studio courses like environmental architecture studio course the reviews may be conducted by internal/external examiners. The same marks may be updated as Internal Assessment marks.

c) Students may be required to complete some courses through online platforms like SWAYAM/NPTEL/Any other reputed online education aggregator. Students are required to choose the courses on the advice of their course coordinator/Director and required to submit the course completion certificate along with percentage of marks/grade scored in the assessment conducted by the online education aggregator. If the online education aggregator has issued a certificate along with the grade or marks scored to students, such courses will be considered for SGPA calculations, in case the aggregator has issued only a certificate and not marks scored, then such courses will be graded through an examination by concerned School, in case, if grading is not possible, students will be given a pass grade and award the credit and the credits will not be considered for SGPA calculations

9. Setting question paper and evaluation of answer scripts.

i. For SEE, three sets of question papers shall be set for each theory course out of which two sets will be by the internal examiners and one set will be by an external examiner. In subsequent years by carrying forward the unused question papers, an overall three sets of question papers should be managed and depending on the consumption of question papers either internal or external examiner be called for setting the question paper to maintain an overall tally of 3 papers with the conditioned mentioned earlier. The internal examiner who sets the question paper should have been course tutor.
ii. The Chairman of BoE shall get the question papers set by internal and external examiners.
iii. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.
iv. There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within

the discipline shall be appointed as moderator.

v. The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.

vi. If a course is fully of (L=0):P:(P=0) type or a course is partly P type i.e, (L=3): (P=0) (D=1), then the examination for SEE component will be as decided by the BoS concerned.

10. Evaluation of studio based courses/Dissertation

10.1 A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;
b) Skills and operations involved;
c) Results / products including portfolio preparation and presentation

10.2 For all courses with an SEE component, the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a) Continuous Internal assessment (CIA) = 50 marks
b) Semester end practical examination (SEE) = 50 marks

The 25 marks for continuous assessment shall further be allocated as under (IA or CIA):

i	*Internal tests*	*30 marks*
ii	*Assignments*	*10 marks*
iii	*Seminars*	*10 marks*
	Total	*50 marks*

The 50 marks meant for Semester End Examination, shall be allocated as under:

i	*Conduction of semester end practical examination*	*50 marks*
	Total	*50 marks*

The above scheme may be redesigned for various types of courses based on the advice of the BOS

10. 3 The SEE for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

The duration for semester-end practical examination shall be decided by the concerned School Board.

10.3. Evaluation of Thesis project

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars/reviews in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final portfolio of the thesis as the case may be, for final evaluation. The components of evaluation are as follows:

1	*First project presentation describing the problem definition*	*Should be done a semester before the project semester*	*Weightage: 0%*
2	*Project Progress presentation-1*	*7^{th} week from the start date of project semester*	*Weightage: 25%*
3	*Project progress presentation-2*	*14^{th} Week from the start date of project semester*	*Weightage -25%*
4	*Final project Viva and*	*17^{th} -20^{th} Week of project*	*Weightage: 30%*

	Project Report Submission	*Semester*	*for Project Portfolio Weightage: 20% for Final Viva Voce*

11. Provision for Appeal

Provision for appeal for re-evaluation of answer scripts is available for students after the results are declared. Students will be required to submit all necessary details along with revaluation fees within the prescribed time period as per University circulars released after the declaration of results.

If a candidate is not satisfied with the evaluation of C1,C2 and C3 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

12. Eligibility to Appear for Semester End Examination (SEE)

12.1 Only those students who fulfill 75% attendance requirement and who secure minimum 30% marks in IA1 and IA2 together in a course are eligible to appear for SEE examination in that course.

12.2 Those students who have 75% of attendance but have secured less than 30% marks in IA1 and IA2 together in a course are not eligible to appear for SEE examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.

12.3 In case a candidate secures more than 30% in IA1 and IA2 together but less than 45% in aggregate of IA1, IA2 and SEE in a course is considered as unsuccessful and such a candidate may either opt to DROP that course or appear for SEE examination during the subsequent semesters/years within the stipulated period.

12.4 In such a case wherein he / she opts to appear for just SEE examination, then the marks secured in IA1 and IA2 shall get continued. Repeat SEE examination will be conducted in respective semesters.

12.5 Requirements to Pass a Course

Students are required to score a total minimum of 45% (Continuous Internal assessment and SEE) in each course offered by the University/ Department for a pass (other than online courses) with a minimum of 20 (40% of 50) marks in final examination

12. 6 Requirements to Pass the Semester

To pass the semester, a candidate has to secure minimum of 45% marks in each subject / course of the study prescribed in that semester.

12. 7 Provision to Carry Forward the Failed Subjects / Courses:

A candidate who secures a minimum of 40% in the SEE and an overall 45% (IA1+IA2+SEE) in a course is said to be successful otherwise considered that the candidate has failed the course. This implies that the candidate has no restrictions on the number of courses that can be carried forward on the condition that program is completed within stipulated 4 years of registration date.

12.8 Re-Registration and Re-Admission:

a) In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for end semester examination and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

13. Attendance Requirement:

13.1. All students must attend every lecture, tutorial and practical classes.

13.2. In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

13.3. Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester (C3) examination and such student shall seek re-admission as provided in 13.1

13.4.Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

14. Absence during Mid Semester Examination:

In case a student has been absent from a mid semester (C1, C2) examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special test for such candidate(s) well in advance before the C3 examination of that respective semester. Under no circumstances C1,C2 test shall be held after C3 examination.

15. Grade Card and Grade Point

Provisional Grade Card: The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).

Final Grade Card: Upon successful completion of M. Arch Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	*Grade G*	*Grade Point (GP=V x G)*	*Letter Grade*
90 to100	*10*	*v*10*	*O*
80 to89	*9*	*v*9*	*A+*
70 to79	*8*	*v*8*	*A*
60 to69	*7*	*v*7*	*B+*
55 to59	*6*	*v*6*	*B*
50 to 54	*5.5*	*V*5.5*	*C*
45 to 49	*5*	*v*5*	*P*
0-44	*0*	*v*0*	*F*
ABSENT			*AB*

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F – Fail

Here, P is the percentage of marks (P=[C1+C2+C3] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

16. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e:

SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

a. **Provisional Grade Card:** The tentative / provisional Grade Card will be issued by the Controller of Examinations at the end of every Semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).This statement will not contain the list of DROPPED courses.

b. **Final Grade Card:** Upon successful completion of the Post Graduate Degree a Final Grade card consisting of grades of all courses successfully completed by the Candidate will be issued by the COE.

17. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 40% (20 marks) in Semester End Examination (SEE) and a minimum of 40% marks overall (IA and SEE together), such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

Mapping of Course Outcomes with Programme Outcomes

Course Code	CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
M23RC0101	CO1	1	2	1	1	3	2	1	2
	CO2	2	3	3	3	3	2	1	2
	CO3	1	3	3	2	2	3	1	2
	CO4	1	3	2	3	3	2	3	3
M23RC0102	CO1	3	3	1	1	2	2	1	2
	CO2	2	3	1	3	2	1	1	3
	CO3	2	3	2	1	1	3	2	2
	CO4	3	1	1	3	1	3	3	2
M23RC0103	CO1	3	2	2	1	2	2	1	2
	CO2	3	3	2	3	3	2	1	2
	CO3	1	2	2	3	3	2	3	2
	CO4	2	3	3	3	3	2	2	2
M23RC0104	CO1	1	2	2	3	3	2	3	3
	CO2	2	3	2	3	3	2	2	3
	CO3	1	2	1	3	3	2	2	2
	CO4	2	3	3	3	3	2	2	2
M23RCPE01	CO1	1	2	3	1	1	3	2	2
	CO2	1	3	1	2	2	2	2	2
	CO3	1	2	1	1	1	3	3	3
	CO4	1	2	2	2	2	3	3	3
M23RCPE02	CO1	1	2	3	3	3	2	2	3
	CO2	1	2	2	3	2	3	3	3
	CO3	1	3	2	2	1	6	3	2
	CO4	1	3	3	2	2	2	3	2
M23RCPE03	CO1	3	2	1	1	2	2	3	3
	CO2	3	3	3	1	2	2	3	3
	CO3	1	3	2	1	1	2	3	3
	CO4	-	-	-	-	-	-	-	-
M23RC0105	CO1	2	2	2	3	2	2	3	3
	CO2	1	2	3	3	3	2	3	3
	CO3	1	3	3	3	3	2	3	3
	CO4	1	3	3	3	3	2	3	3
M23RC0201	CO1	2	3	3	3	3	3	3	3
	CO2	2	2	3	3	3	2	3	3
	CO3	2	3	3	3	3	3	3	3
	CO4	3	3	3	3	3	3	3	3
M23RC0202	CO1	1	3	2	3	3	2	3	3
	CO2	2	3	3	2	2	2	3	3
	CO3	2	3	3	3	3	2	3	3
	CO4	3	2	3	2	2	3	3	3
M23RC0203	CO1	1	2	2	2	2	1	3	3
	CO2	1	2	2	2	2	1	3	3
	CO3	2	2	2	2	2	1	3	3
	CO4	2	2	2	3	2	1	3	3
M23RC0204	CO1	3	2	2	2	2	3	3	3
	CO2	3	2	2	2	2	3	3	3
	CO3	1	2	2	2	2	3	3	3
	CO4	2	2	2	2	2	3	3	3
M23RC0205	CO1	2	2	2	2	2	2	2	2

	CO2	2	3	3	3	3	2	3	3
	CO3	2	3	3	3	3	2	3	3
	CO4	2	3	3	3	3	2	3	3
M23RCPE04	CO1	2	1	3	3	2	1	2	2
	CO2	1	3	2	3	2	1	2	2
	CO3	1	3	2	3	2	1	2	2
	CO4	2	3	2	3	2	1	3	3
M23RCPE05	CO1	3	2	2	3	2	1	3	3
	CO2	1	2	2	3	2	1	3	3
	CO3	1	2	2	3	2	1	3	3
	CO4	1	2	2	3	2	1	3	3
M23RCPE06	CO1	2	3	3	2	3	1	3	3
	CO2	1	3	3	2	3	1	3	3
	CO3	3	3	3	2	3	2	3	3
	CO4	3	3	3	2	3	3	3	3
M23RC0206	CO1	1	2	2	3	3	1	3	3
	CO2	1	3	3	3	3	1	3	3
	CO3	2	3	3	3	3	1	3	3
	CO4	1	3	3	3	3	1	3	3
M23RC0301 Practical Training									
M23RC0401	CO1	1	3	3	3	3	3	3	3
	CO2	3	3	3	3	3	2	3	3
	CO3	1	3	3	3	3	1	3	3
	CO4	1	3	3	3	3	3	3	3
M23RC0402	CO1	2	2	2	2	2	3	3	3
	CO2	2	3	3	3	2	3	3	3
	CO3	2	3	3	3	2	3	3	3
	CO4	3	3	3	3	2	3	3	3

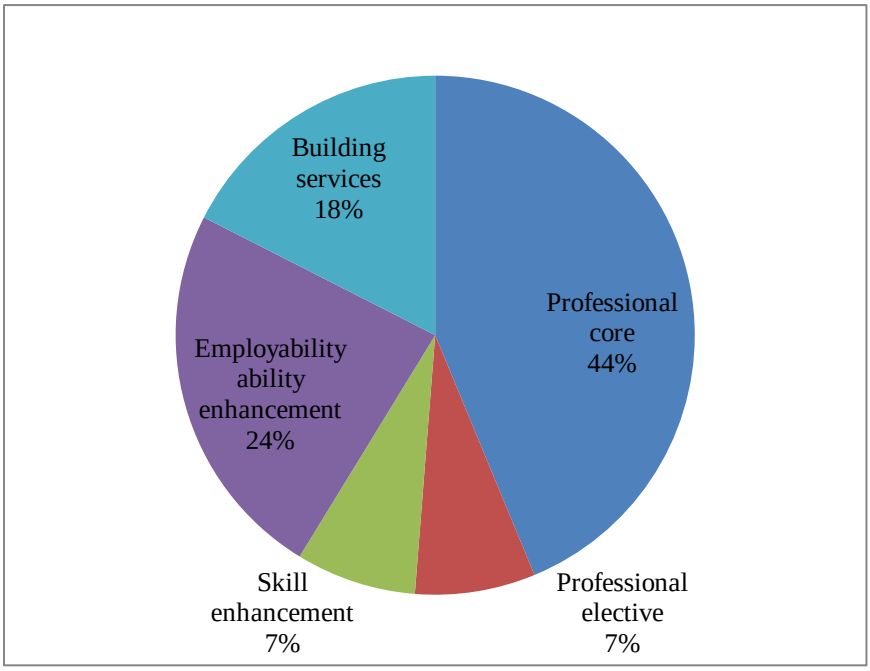
Mapping of PEO's with respect to PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
PEO1	2	3	3	2	2	3	3	3
PEO2	2	3	3	3	3	2	3	3
PEO3	3	3	3	3	3	3	3	3
PEO4	1	2	2	2	2	3	3	3

M. Arch Programme Scheme and credit structure 2023-2025 batch					
Course Code Format					
	Level of Degree	**Year of introduction of course**	**Program Name**	**Semester**	**Course no**
HC courses	**M**	**21**	**RC**	**01**	**01**
Professional Elective courses	**M**	**21**	**RC**	**PE**	**01**

Scheme and Credit Structure							
Sl. no.	**Course code**	**Course**	**Category**	**Credits**	**Hours**	**LPD**	**Evaluation**
I SEMESTER							
1	M23RC0101	Environmental Design Studio-1	Professional core	7	8	3:1:3	Viva-Voce
2	M23RC0102	Sustainable building materials & Technology- I	BS	4	4	4:0:0	SEE
3	M23RC0103	Fundamentals of Environmental Design	Professional core	3	3	3:0:0	SEE
4	M23RC0104	Building Services – I Day lighting & Ventilation in Buildings	BS	3	3	3:0:0	SEE
5		Elective - I	Professional elective	3	3	3:0:0	SEE
a.	M23RCPE01	Climate change & disaster risk assessment					
b.	M23RCPE02	Solid and hazardous waste management					
c.	M23RCPE03	Water Management					
6	M23RC0105	Digital tools & simulation software	Skill enhancement	3	3	2:2:0	Viva-voce
TOTAL				**23**	**24**		
II SEMESTER							
Sl. no.	**Course code**	**Course**	**Category**	**Credits**	**Hours**	**LPD**	**Evaluation**
1	M23RC0201	Environmental Design Studio- II	Professional core	7	8	3:1:3	Viva-voce
2	M23RC0202	Advanced Sustainable building materials & Technology- I	BS	4	3	4:00	SEE
3	M23RC0203	Advanced Research writing	Professional core	3	3	4:00	Internal
4	M23RC0204	Environmental Law, Green Building codes & Standards	EEC	3	3	4:00	SEE
5	M23RC0205	Building Services – II Thermal comfort and Indoor Air quality	BS	3	3	4:00	SEE
6		Elective - II	Professional elective	3	3	4:00	SEE
a.	M23RCPE04	Intelligent building systems					
b.	M23RCPE05	Geo Informatics					
c.	M23RCPE06	MEP in design efficiency					

7	M23RC0206	Advanced Digital tools & simulation software	Skill enhancement	3	3	2:2:0	Viva-voce
TOTAL				**26**	**26**		
III SEMESTER							
Sl. no.	**Course code**	**Course**	**Category**	**Credits**	**Hours**	**LPD**	**Evaluation**
1	M23RC0301	Professional training	EEC	16	32	0:32:0	Internal
TOTAL				**16**	**32**		
IV SEMESTER							
Sl. no.	**Course code**	**Course**	**Category**	**Credits**	**Hours**	**LPD**	**Evaluation**
1	M23RC0401	Thesis	Professional core	12	6	3:0:6	Viva-voce
2	M23RC0402	Environment and energy Resource economics	Professional core	3	3	3:0:0	SEE
TOTAL				**15**	**9**		
GRAND TOTAL CREDITS: 80							



	No of credits	**%**
Professional core	35	44
Professional elective	6	8
Skill enhancement	6	8
Employability ability enhancement	19	24
Building services	14	18

Detailed Curriculum

DETAILED SYLLABUS FOR I SEMESTER COURSES

Sl. no.	Course	Category	Credits	Hours
1	Design Studio-1	Professional core	7	8

DESIGN STUDIO -1

COURSE OUTLINE*:* Design of small-scale built-up spaces by taking into consideration various climatic end environmental design principles. The building shall be designed to minimize energy use while maintaining functionality, accommodation standards, occupant health, safety or comfort.

COURSE OBJECTIVES

1. To familiarize the students with role of microclimatic analysis in the architectural design process.
2. To introduce Energy performance analysis as a basis for architectural design solutions
3. To familiarize students with tools required for climatic and environmental design which minimizes energy
4. To impart skills in communication of design proposal through drawings, models, simulation analysis reports etc.

COURSE OUTCOMES: Upon completion of the course, students shall be able to-

1. Comprehend and analyse the role of climate in environment friendly design proposals.
2. Gain familiarity with energy performance analysis and its applications in architectural design.
3. Propose design solutions which minimize energy usage in the built environment.
4. Acquire skills in effectively communicating the design proposal through drawings, reports and models.

UNIT-1

Understanding of site and user requirement; Site and context analysis; Microclimatic analysis - Bio climatic and psychometric analysis of comfort zone; concept formulation with focus on environmental friendly design

UNIT-2
Whole building Analysis for Energy performance based on heat gain and heat loss
Indoor thermal comfort, Solar Analysis for optimizing Orientation, Shading and shading
analysis, thermal and daylighting analysis; Development of single line plans, draft sections and elevations

UNIT-3
Application of Passive energy conservation measures (performance evaluation of passive strategies like,
stack effect, thrombe wall, radiant cooling system etc.,); Detailed energy analysis report of the proposed building

UNIT-4
Preparation of design portfolio in form of Drawings, calculations, models and reports.

Digital simulation tools for Whole building energy performance will be introduced in Environmental Lab

REFERENCES:

1. IS:3362-1977, Indian Standard, code of practice For Ventilation of Residential Building
2. Rea, M., 2000. *The Lighting Handbook*. 9th ed. Illuminating Engineering Society of North America,
3. SP 41 (1987) Handbook on Functional Requirements Of Non-industrial Buildings (Lighting And Ventilation), BIS
4. Steven szokolay, 2008, Introduction to architectural science. Taylor & Francis group, UK

Sl. no.	Course	Category	Credits	Hours
2	Sustainable building materials & Technology- I	Professional core	4	3

SUSTAINABLE BUILDING MATERIALS AND TECHNIQUES-I

COURSE OUTLINE: The course is designed to give students an overview of building materials and techniques which can help in the design of sustainable built environment. Students are introduced to a mix of traditional and modern materials and techniques along with an overview of environmental impact of the building materials.

COURSE OBJECTIVES:

1. To familiarize students with traditional knowledge systems, natural materials and techniques for passive climate-oriented design
2. To introduce the characteristic properties and technical applications of advanced synthetic building materials
3. To familiarize students with the empirical methods to evaluate the environmental impact of building materials.
4. To introduce the concept of life cycle analysis with respect to environmental design considerations.

COURSE OUTCOMES: On successful completion of the course, students shall be able to-

1. Describe, detail and apply traditional knowledge systems, natural materials and techniques for passive climate-oriented design
2. Demonstrate an understanding of advanced building materials and their applications in environmental design.
3. Evaluate the environmental impact of building materials through embodied energy analysis
4. Demonstrate an understanding of Life cycle analysis with respect to design for environmental sustainability.

UNIT I MATERIALS & TECHNIQUES FOR PASSIVE DESIGN

Traditional knowledge systems– Biodegradable & Non-Biodegradable Materials; Regional materials, rapidly renewable materials – Fly ash bricks, Cement – Recycled Steel, Bamboo based products

Passive Design and Material Choice – Traditional Building Materials – Importance of envelope material in internal temperature control – Specification for walls and roofs in different climates; Energy Efficient Construction Technology – Filler Slab – Rat trap Bond – Technologies developed by CBRI – Traditional Building Construction Technologies

UNIT II ADVANCED BUILDING MATERIALS

Aluminum, glass, fabric, various types of finishes & treatments, Construction chemicals –sealants, engineering grouts, mortars , admixtures and adhesives; self healing concrete, bending concrete, Self compacting concrete, Non - Weathering Materials-Flooring And Facade Materials- Glazed Brick, Photo Catalytic Cement, Acid Etched Copper And Composite Fiber. Metals-Metals And Special Alloys Of Steel-Water Jet Cut Stainless Steel, Mill Slab Steel

UNIT III ENVIRONMENTAL IMPACT OF BUILDING MATERIALS

Measuring the impact of building materials- calculating embodied energy- recycling and embodied energy- processing and embodied energy- time and embodied energy- embodied energy of different building materials- low energy building and masonry materials- life cycle analysis- Case studies and analysis

UNIT IV LIFE CYCLE ANALYSIS

History of LCA, Aspects of LCA, variants of LCA, Life cycle stages, end of life, Functional unit, System boundary, Life Cycle Inventory (LCI) data base, Life Cycle Management (LCM), Life Cycle Energy Analysis (LCEA), Carbon Accounting, Building for Economic and Environmental Sustainability (BEES), International LCA Tools, Guidelines to integrate: LCA with design and evaluation

References-

1. Brownell, Blaine Erickson, ed. *Examining the Environmental Impacts of Materials and Buildings*. IGI Global, 2020.
2. Achal, Varenyam, and Abhijit Mukherjee, eds. *Ecological wisdom inspired restoration engineering*. Springer Singapore, 2019.

3. Pacheco-Torgal, Fernando, Luisa F. Cabeza, João Labrincha, and Aldo Giuntini De Magalhaes. *Eco-efficient construction and building materials: life cycle assessment (LCA), eco-labelling and case studies*. woodhead Publishing, 2014.
4. WBLCA Guide Special Project Working Group. "Whole Building Life Cycle Assessment: Reference Building Structure and Strategies." Reston, VA: American Society of Civil Engineers, 2018.
5. Crawford, Robert. *Life cycle assessment in the built environment*. Routledge, 2011.

Sl. no.	Course	Category	Credits	Hours
3	Fundamentals of Environmental Design	Professional core	3	3

FUNDAMENTALS OF ENVIRONMENTAL DESIGN

COURSE OBJECTIVES:

1. To familiarize students with Ecological concepts which form the basis of sustainable architecture and design
2. To equip students with knowledge of building physics for climate sensitive passive thermal design
3. To introduce students to principles and components of whole building energy audit and green building rating systems used in India.
4. To familiarize students with passive design strategies used in traditional and contemporary building systems.

COURSE OUTCOMES: On successful completion of the course, students shall be able to

1. Gain an understanding of basic concepts linked to ecology and sustainability for designing environmentally sensitive built environment
2. Comprehend principles of thermal design based on climate analysis
3. Acquire knowledge of tools for sustainable building design and whole building energy audit
4. Describe and analyse traditional and contemporary techniques used for energy efficient design

UNIT I **Ecological concepts:** Evolution and process, eco-systems, adaptation, ecological pyramids, material cycles- carbon, nitrogen and sulphur cycles, watershed, carrying capacity, ecological footprint. Impacts of urbanization: Modifications of natural environment- causes and consequences, environmental pollution, climate change, basics of water crisis & solid waste management issues

Sustainable Architecture: Theory and principles, concept of sustainable development, principles of sustainable development, indicators of sustainable development, variables of sustainability and their relation to real world with appropriate examples, use of sustainability variables in identification of sites and development of habitations, towns and cities.

UNIT II BUILDING PHYSICS

Climate Analysis: Earth-Sun relationship, Global Climate, Elements of Climate, Climatic zones in India, Analysis of macro & micro climate. Interpretation of climatic data through Climate Data, Solar Path Charts, Psychometric Charts, Bioclimatic charts.

Principles of Thermal Design: Thermal quantities, Heat exchange in buildings, balance point temperature and periodic heat flow. Passive solar architecture; Minimizing cooling needs by building design, Passive solar configuration; outline of various passive systems for heat gain, indirect gain, trombe wall, water wall and trans wall, sun space , solarium, conservatory, roof pond ,sky-therm, vary thermal wall, earth sheltered ,earth bermed structures and earth-air tunnels.

UNIT III **TOOLS FOR SUSTAINABILE BUILDING DESIGN**

Whole Building Energy Audit, Carbon Footprint and Mapping

Green Building Rating Systems, Energy Conservation Building Codes

UNIT IV **DESIGN STRATEGIES**

Design of buildings to use renewable energy, optimization of materials use, strategies for water- efficiency in design through Siting & Land Use

Traditional and contemporary knowledge systems in the realm of environmental architecture, Case study of energy efficient and sustainable Vernacular and Contemporary buildings in India- methods, strategies, systems, and construction details emphasizing the passive architecture and non active services.

REFERENCES:

1. Brenda and Robert Vale; Green Architecture- Design for a Sustainable Future; Thames and Hudson; 1996

3. Catherine Slessor; Sustainable Architecture and High Technology- Eco Tech; Thames and

Hudson; 1997
2. Daniel Vallero and Chris Brasier; Sustainable Design- The science of sustainability and Green Engineering;Wiley; 2008
4. Dominique Gauzin- Muller; Sustainable architecture and Urbanism; Birkhauser; 2002.

Sl.no.	Course	Category	Credits	Hours
4	Building Services – I **Day lighting & Ventilation in Buildings**	BS	3	3

COURSE OBJECTIVES:

1. To introduce theoretical concepts related to daylighting design
2. To familiarize students with application of daylighting concepts in building design
3. To introduce theoretical concepts related to ventilation to students
4. To familiarize students with techniques used for ventilation for Environmental architecture.

COURSE OUTCOMES: On successful completion of the course, students shall be able to:

1. Define and describe basic concepts related to daylighting design
2. Apply principles of daylighting design for environmental architectural design solutions
3. Define and describe basic concepts related to ventilation
4. Apply techniques of ventilation for environmental architectural design

UNIT I Passive Daylighting - Electromagnetic spectrum, Direct, diffuse and reflected components. Colour perception, Visual Task Requirements. Side lighting concepts, Top lighting concepts. Designing Atria / Light Courts. Daylight Controls. Daylighting Design. Design Parameters: Glare, critical indoor and outdoor luminance, daylight factor and its calculation and distribution.

UNIT II Active Daylighting Strategies-Techniques of Incorporating Daylight in Buildings. Intelligent and Smart way of Daylighting with Control devices: Smart glasses for daylighting and its different application in the buildings. ECBC, IGBC and Griha guidelines for different building and their application in the building. Daylighting and Lighting Design for Emission reduction.

UNIT III Planning for Ventilation - Functions of ventilation -Stack effect – calculations – provision for Air movement, air flow through buildings, calculation of indoor air velocity, ventilation rate, orientation, external features, cross ventilation , position of openings, size of openings, controls of openings- calculations- air flow around buildings , humidity control.

UNIT IV Ventilation Techniques- Requirements of ventilation as per ASHRAE / ECBC - Natural ventilation: stack effect, courtyard effect, air changes, ventilation requirement calculations, cross ventilation - Artificial ventilation techniques: forced ventilation, fresh air systems, pre-cooling of fresh air - Heat recovery through economizers and desiccant wheels - Humidity control systems, demand-controlled ventilation. Natural ventilation and mechanical ventilation design strategies for reducing emissions. Smart way of Ventilation with controllers and mechanical Ventilation.

References:

1. Martin Evans, Housing, Climate and comfort, Architectural Press, London 1980
2. Handbook of functional requirements of Buildings, Bureau of Indian standards SP41, 1987
3. David Egan, Concepts in Thermal comfort, Prentice Hall, 1975
4. Energy Conservation Building Code of India, User manual, 2007

Sl.no.	Course	Category	Credits	Hours
5	Elective - I	Professional elective	3	3
a.	**Climate change & disaster risk assessment**			
b.	Solid and hazardous waste management			
c.	Water Management			

CLIMATE CHANGE & DISASTER RISK ASSESSMENT

COURSE OBJECTIVES -

1. To introduce concepts of climate change, its impacts and related policies
2. To introduce concepts of water management in light of climate change and its impacts on vulnerable groups.
3. To expose the students towards the disaster risk assessment practices and their importance at macro, micro and built form level.
4. To familiarize students with best practices in disaster risk management using case studies from around the world.

COURSE OUTCOMES- On successful completion of the course students shall be able to-

1. Demonstrate an understanding of the built environment related challenges created due to climate change.
2. Demonstrate the ability to assess risk reduction needs and adaptation requirements.
3. Acquire knowledge regarding basic principles and applications of disaster risk assessment and management.
4. Imbibe best practices in disaster risk management for environmentally sensitive design solutions.

UNIT I - **Introduction to climate change**, urban environment – Introduction to climate change, urban environment and adaptation, Climate change policies

UNIT II- **Climate Change** Impacts onInformal settlements, urban poor and vulnerable groups, Societal Vulnerability to climate change, Climate Change Impacts on Natural Resources: Air pollution, Biodiversity and Climate Change, Climate Change Impact Assessments.

UNIT III- **Disaster Risk management** – Introduction to vulnerability, hazards and disaster risks Opportunities for Resilience, risk management framework consisting of mitigation, preparedness, disaster, response, recovery and reconstruction phases.

UNIT IV- **Case studies** of best practices in disaster risk management from all over the world
Mitigation efforts Tsunamis including Hazard Maps (Warning Centre - Hyderabad); Example Chennai Coastline
Earthquake Risk & Impart – Examples -Japan & Sikkim

References

1. Leary, N.; Adejuwon, J.; Barros, V.; Burton, I; Kulkarni, J and Lasco, R. (eds): Climate Change and Adaptation, Earthscan. Earthscan, 2009.
2. Shaw, R.; Pulhin, J. and Pereira, J.: Climate Change Adaptation and Disaster Risk Reduction: Issues and Challenges. Emerald Group Publishing, 2010.
3. UNISDR: Climate Change and Disaster Risk Reduction, Briefing Note 01. UN, 2008.
4. Bankoff, G.; Frerks, G.; and Hilhorst, D (eds): Mapping Vulnerability. Disaters, Development and People. Earthscan, 2004
5. Climate Change Strategies, Espinosa, P. et, al. 2020, Climate Technology Centre & Network, Denmark
6. Climate Change Vulnerability Assessments: An Evolution of Conceptual Thinking. Climatic Change.Füssel, H.-M., & Klein, R. J. T. (2006).
7. Disaster Management and Environmental Care. Abletez, J.P. 200

Sl.no.	Course	Category	Credits	Hours
5	Elective - I	Professional elective	3	3
a.	Climate change & disaster risk assessment			
b.	**Solid and hazardous waste management**			
c.	Water Management			

SOLID AND HAZARDOUS WASTE MANAGEMENT

COURSE OBJECTIVES -

1. Knowledge of legal, institutional and financial aspects of management of solid wastes.
2. Understanding the problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste
3. To expose the Environment and health impacts solid waste mismanagement.
4. To familiarizeengineering, financial and technical options for waste management.

COURSE OUTCOMES- On successful completion of the course students shall be able to-

1. Demonstrate health and environmental issues related to solid waste management.
2. Characterize solid and hazardous wastes from technical and regulatory points of view.
3. Identify the applicationof solid waste management treatment process.
4. Describe theenvironmental optimization of solid wastedisposal techniques.

UNIT I - Introduction to Solid Waste Management – Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management. Solid waste Management Rules and Guidelines.

UNIT II- Fundamentals of Hazardous Waste Management Fundamentals Sources; composition; generation rates; collection of waste; separation, transfer and transport of waste; treatment and disposal options.

UNIT III- Treatment of Solid and Biomedical Waste – Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes) Biological Treatment: Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT IV- Disposal: Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration. landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation. Waste to energy – Bio methanation, Refuse Derived Fuel, Incineration. Life Cycle assessment. Special waste management.

References

1. LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 1994.
2. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.
3. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York, 1997.
4. George Techobanoglous et al, ‖Integrated Solid Waste Management‖, McGraw - Hill, 2014. Manual on Municipal Solid waste Management, CPHEEO, Ministry of Urban Development, Govt. Of. India, New Delhi, 2000.
5. TechobanoglousThiesenEllasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

Sl.no.	Course	Category	Credits	Hours
5	Elective - I	Professional elective	3	3
a.	Climate change & disaster risk assessment			
b.	Solid and hazardous waste management			
c.	**Water Management**			

WATER MANAGEMENT

COURSE OBJECTIVES -

1. To introduce concepts of water management from traditional settlements.
2. To expose the students towards the water management practices and their importance at macro level.
3. To familiarize the students with water management practices and their importance at micro level.
4. To describe strategies to reduce water consumption in buildings

COURSE OUTCOMES –

On successful completion of the course students shall be able to:

1. Assimilate traditional knowledge systems related to water management in India
2. Comprehend water management practices at macro and micro levels
3. Describe and apply strategies for efficient water consumption in buildings

UNIT I -Water management – Macro level -Management of the water cycle as a single system - Management of water supply, sanitation and drainage - Social imperatives, environmental considerations and economic challenges - Technological options for water management, recycling, reuse, conservation and treatment - Planning of settlements and large campuses based on principles of sustainable watershed development with water as a priority resource

UNIT II- Urban utilities Planning issues, Planning strategies and urban utilities, Water sensitive urban planning, Water demand prediction and management. Griha and IGBC guidelines for the conservation of water in the building. Strategies to reduce water consumption in buildings- Low flow plumbing fixtures for water efficient appliances.

UNIT III- Rainwater harvesting - Reuse of grey water for non-potable uses – Rainfall, Runoff and ground water, groundwater Properties and Flow Characteristics, Groundwater intakes and Issues, Surface water intakes

UNIT IV- Sanitation basic systems, Sewage system, Storm water drainage planning for water conservation, Runoff estimation. Natural and Artificial sewage treatment for water reuse.

References:

1. Gurcharan Singh, Jagdish Singh, Water Supply & Sanitary Engineering, Standard Publishers Distributors, 2007
2. Ramaswamy R. Iyer, Water and the laws in India, Sage Publications India Pvt. Ltd, 2009
3. Hydrology and Water Resources of India, Water Science and Technology Library, Vol. 57, Jain, Sharad K., Agarwal, Pushpendra K., Singh, Vijay P. Springer,2007
4. K. Nageswara (Ed.), Water Resources Management: Realities and Challenges, Eastern Book Corpn., 2006
5. Dr B C Punmia, Ashok Kr Jain, Arun Kr Jain; Water Supply Engineering, Laxmi, Cunliffe, D. (ed) (2011), Water safety in buildings, World Health Organization, Geneva, Switzerland,2011

Sl.no.	Course	Category	Credits	Hours
6	Digital tools & simulation software	Skill enhancement	3	3

DIGITAL TOOLS & SIMULATION SOFTWARE

COURSE OBJECTIVES -

1. Introduction software simulation tools like Design builder, Meteonorm
2. Understanding the practical knowledge of software related to environmental architecture field.
3. To model building performance using energy simulation software.
4. To use measured building energy data to calibrate simulation model.

COURSE OUTCOMES- On successful completion of the course students shall be able to-

1. Demonstrate environmental Simulation principles and analysis of buildings.
2. familiar with the fundamental simulation engines and integrated tools
3. Visualize and interpret the results of simulations.
4. Integrate the strategies based on the simulation results.

UNIT I - **Introduction to interface**– Introduction to Simulation Software, any environmental prediction software package in architecture.

UNIT II- **Application of Tools:** to study the simple and intuitive 3D modelling interface and to explore the range of analysis functions.

UNIT III- **Modelling and Simulations–** Generate and analyse climate data for any geographic location, predict microclimatic conditions on urban sites, perform shading, daylighting, airflow, heating and cooling simulation studies, predict indoor temperatures and other environmental conditions,

UNIT IV- **Analysis of buildings:** calculate energy requirements and assess environmental impact and life costs of buildings.

References:

1. Design Builder 2.1 User's Manual © 2009 Design Builder Software
2. Building Energy Simulation: A Workbook Using Design BuilderTM Book by Aviruch Bhatia, Jyotirmay Mathur, and Vishal Garg

Sl.no.	Course	Category	Credits	Hours
7	Environmental LAB- I (integrated with Design Studio I)	Skill enhancement	-	-

COURSE OBJECTIVES: -

1. To familiarize students with basics of modelling and simulation
2. To impart software skills in climatic analysis of buildings
3. To impart software skills in lighting analysis for buildings
4. To familiarize students with thermal comfort analysis of buildings using suitable software.

COURSE OUTCOME**: On completion of the course, students shall be able to-**

1. Gain familiarity with modelling and simulation softwares for building energy analysis
2. Acquire skills in use of software for climatic analysis of buildings
3. Acquire skills in use of software for lighting analysis for buildings
4. Gain familiarity with thermal comfort analysis of buildings using suitable software.

UNIT I Introduction: Introduction to simulation software, basic modelling, parameters for simulation analysis
UNIT 2 Basic Analysis: Tools for Climatic analysis, shadow analysis, Solar Analysis for optimizing Orientation material selection etc.
UNIT 3 Lighting Analysis: Tools for Calculations and inferences for day lighting and application of artificial lighting along with its analysis.
UNIT 4 Thermal Comfort Analysis: Tools for Calculations for thermal comfort of spaces and its associated parameters like heat gains-losses, temperature profiles, fabric gains-losses, ventilation etc.
Tools for the above will be taught in Environmental lab. Practice and application projects to be covered as a part of Design Studio 1.
Books and References:
Manuals & Video Tutorials on selected simulation software, as guided by the concerned faculty.

CURRICULLUM AND SCHEME FOR II SEMESTER M. ARCH

Sl. no.	Course	Credits	Hours
1	**Design Studio- II**	**7**	**8**
2	**Advanced Sustainable building materials & Technology- I**	**4**	**3**
3	**Research methodology and statistical techniques**	**3**	**3**
4	**Environmental Law, Green Building codes & Standards**	**3**	**3**
5	**Building Services – II Thermal comfort and Indoor Air quality**	**3**	**3**
6	**Elective - II**	**3**	**3**
a.	**Intelligent building systems**		
b.	**Geo Informatics**		
c.	**MEP in design efficiency**		
7	**Advanced Digital tools & simulation software**	**3**	**3**
	TOTAL	**26**	**26**

DETAILED SYLLABUS FOR M. ARCH II SEMESTER COURSES

Sl.no	Course	Category	Credits	Hours
1	Design Studio- II	Professional core	7	8

DESIGN STUDIO -2

COURSE OUTLINE-Design of a medium to large scale building for public use. Eg- Hotel, office building etc. The design shall exhibit sensitivity to site context and conditions and aim towards achieving and environmental friendly solution encompassing building design, site planning and services inclusion.

COURSE OBJECTIVES

1. To familiarize the students with whole building thermal/ energy analysis in the architectural design process.
2. To introduce lighting, ventilation and IAQ as a basis for architectural design solutions
3. To familiarize students with tools required for efficient building services and site management
4. To impart knowledge of embodied energy and carbon footprint of buildings

COURSE OUTCOMES: Upon completion of the course, students shall be able to-Check blooms verbs in outcomes

1. Comprehend and analyse the role of whole building thermal/ energy analysis in environment friendly design proposals.
2. Gain familiarity with lighting, ventilation and IAQ analysis and its applications in architectural design.
3. Propose design solutions which exhibit efficient building services and site management
4. Acquire skills in evaluating embodied energy and carbon footprints of building proposals.

UNIT-1

Understanding of site and user requirement; Site and context analysis; concept formulation with focus on environmental friendly design ; Solar Analysis for optimizing Orientation, Shading and glazing areas; Detailed whole building thermal / Energy Simulation to achieve thermal comfort indoors through detailed analysis.

UNIT-2

Building Analysis for Day lighting and artificial Lighting, Natural ventilation and Indoor air quality, Fine tuning of design as per the analysis and simulation results. Development of single line plans, draft sections and elevations

UNIT-3

Development of Master Plan with focus on Site Planning & Water Management; provision of Rainwater Harvesting, wastewater recycling and construction waste usage and other waste management strategies
Inclusion of building services with focus on energy efficiency; Development of masterplan, double line plans, sections and elevations.

UNIT-4

Embodied energy calculations using online simulation tools**;** Carbon foot print analysis using online simulation tools**;** Portfolio preparation in the form of drawings, models and reports.

REFERENCES:

1. Givoni Baruch, "Passive and Low Energy Cooling of Buildings", Van Nostrand Reinhold, New Yord, 1994
2. Steven V szokolay, 2008, *Introduction to architectural science*. Taylor &Francisgroup,UK
3. https://www.designbuilder.co.uk
4. https://www.iesve.com/

Sl.no.	Course	Category	Credits	Hours
2	Advanced Sustainable building materials & Technology	BS	4	3

ADVANCED SUSTAINABLE BUILDING MATERIALS AND TECHNOLOGY

COURSE OBJECTIVES-

1. To familiarize students with design principles and examples of dynamic facades
2. To impart knowledge about principles and materials for design of intelligent buildings
3. To describe application of biomimicry techniques towards energy efficient design
4. To familiarize students with concept, parameters and process of EIA.

COURSE OUTCOMES-On successful completion of the course students shall be able to-

1. Describe and apply design principles and examples of dynamic facades
2. Gain familiarity with principles and materials for design of intelligent buildings
3. Describe and apply application of biomimicry techniques towards energy efficient design
4. Assimilate and apply the concept, parameters and process of EIA.

UNIT-I DYNAMIC FACADE DESIGN

Responsive facades, dynamic facades, exoskeletal structures, Kinetic structures, responsive facades, case studies of exemplary building projects

UNIT-II BUILDING MATERIALS FOR INTELLIGENT BUILDINGS

Role of actuators and Actuator Materials in Intelligent building design– Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electrorheological Fluids– Electromagnetic actuation
Nanomaterials and polymers -Green materials, including biomaterials, biopolymers, bioplastics, and composites Nanotech Materials for Sustainable Construction -Structural Plastics And Composites- Polymer Membranes-Coatings-Adhesives

UNIT-III BIOMIMICRY TECHNIQUES IN ARCHITECTURE

Strategies of Nature's Design Solutions, Structural biomimicry applications, Water and thermal biomimicry applications, Solar and bioluminescence biomimicry applications, case studies

UNIT-IV INTRODUCTION TO ENVIRONMETAL IMPACT ASSESMENT

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. EIA process- screening – scoping - setting– analysis – mitigation. Examples and case studies of sectoral EIA

REFERENCES:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996.
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
3. Nick Harvey, Beverley Clarke, Environmental Impact Assessment: Procedures and Practices, Oxford University Press, USA, 2012.
4. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science,,London, 1999.
5. World Bank –Source book on EIA.

Sl.no.	Course	Category	Credits	Hours
3	Research methodology & statistical methods	Professional core	3	3

RESEARCH METHODOLOGY & STATISTICAL METHODS

Course Objectives-

1. Introduce students to Research in the field of environmental architecture and basics of statistics
2. Familiarize students with tools and statistics for data collection
3. Introduce tools and techniques for data interpretation and analysis
4. Impart skills in data modelling and report writing

Course Outcomes-On successful completion of the course, students shall be able to

1. Gain familiarity with research in environmental architecture
2. Design and describe experimental studies using statistical techniques
3. Carry out data analysis and modelling using statistical techniques
4. Compile and communicate research findings through effective report writing

UNIT I Introduction to research

Definitions, meaning and need of research, criteria of a good research, different perspectives and types of research, research ethics

STATISTICAL METHODS:Environmental models – deterministic and stochastic;generation of environmental data; concept of random variableand its relevance with respect to the environmental data; relevance of statistics in environmental management;Measurement scales; statistical descriptors of environmentaldata – numerical and graphical

Research Question, Hypothesis, Aim, Objectives, scope, limitations

UNIT II Introduction to environmental statistics

Selection of research topic, Abstract writing, Keywords, Background study and literature survey, Need and purpose of sampling;

STATISTICAL METHODS: Sampling theory, sampling distributions; sample size determination. methods for selecting sampling locations and times for different environmental matrices types of sampling designs –probability and non-probability sampling designs for environmental monitoring and sampling

Introduction to Research design

UNIT III Data analysis

STATISTICAL METHODS: Analysis tools using qualitative and quantitative methods, Hypothesis testing – parametric and non-parametric tests, Measuring association between two variables – Correlationanalysis: graphical analysis, covariance, correlationcoefficient, distribution of correlation coefficient and itsstatistical significance.

Use of statistical software such as R / SPSS or similar

Introduction to Methods and results section

UNIT IV Report writing

STATISTICAL METHODS: Empirical model building – Regression analysis: assumptionsand definitions, principle of least squares, regressionparameters their distribution and statistical significance, introduction to multiple linear regression, Introduction to time-series analysis

Report writing- Discussions, conclusions and referencing

REFERENCES:

1. Ayyub, B.M. and McCuen, R.H. (2011) Probability, Statistics and Reliability forEngineers and Scientists, CRC Press, Boca Raton, FL.
2. Gilbert R.O. (1987) Statistical Methods for Environmental Pollution Monitoring, New York,VanNostrand Reinhold.
3. Helsel D.R. and Hirsch R.M. (1997) Statistical Methods in Water Resources, ElsevierScience Ltd., UK.
4. Kottegoda N.T. and Rosso R. (2008) Applied Statistics for Civil and EnvironmentalEngineers, McGraw-Hill, International Edition.

Sl.no.	Course	Category	Credits	Hours
4	Environmental Law, Green Building codes & Standards	Professional core	3	3

ENVIRONMENTAL LAW, GREEN BUILDING CODES & STANDARDS

COURSE OBJECTIVES -

1. Knowledge of international developments, environmental laws and legislations in India
2. Understanding the role of law, policy and institutions in conservation
3. Describes the management of natural resources as well as pollution control.
4. To familiarize Green building codes and standards

COURSE OUTCOMES- On successful completion of the course students shall be able to-

1. Familiar with the laws, policies and institutions in the field of environment
2. Understanding environment protection policies
3. To equip the students with the skills needed for interpreting laws, policies and judicial decisions.
4. Acquire ability to evaluate the role of energy conservation and green building.

UNIT I -**Environmental laws and legislation:** Implementation. Environmental Policies and ProgrammesWater Act, 1974, Air Act, 1981, Energy Conservation Act, 2001, Public Liability Insurance Act, 1991 and Biodiversity Act 2002.

UNIT II- **Environment (protection) Act** 1986, rules to regulate environment pollution and Prevention, control and abatement of environmental pollution and institutional.
mechanism.

UNIT III- **Environmental Notifications and Rules:** Costal Regulation Zones, Environment Impact Assessment of Development Projects, Bio-Medical Waste (M&H) Rules, 1998, Hazardous Waste (M&H) Rules, 1989, Municipal Solid Waste (M&H) Rules, 2000.

UNIT IV- Green building code & Standards – Introduction and guidelines of ECBC 2007, The Indian Green Building Council and LEED, The Energy and Research Institute and the GRIHA System, policy guidelines of
sustainable architecture, mandatory requirements, the Energy Conservation Act, 2001 (52 of 2001) its legal framework,

References

1. Leela Krishnan; Environmental Law in India
2. Birnie PW and Boyle; International law and the Environment
3. Saksena K.D ; Environmental policies and programs in India
4. The Environment (protection) Act 1986
5. The Energy Conservation (Amendment) Act 2001, and Amendments
6. Energy conservation building code 2007
7. National building code – India.

Sl.no.	Course	Category	Credits	Hours
5	Building Services – II **Thermal comfort and Indoor Air quality**	BS	3	3

BUILDING SERVICES – II: THERMAL COMFORT AND INDOOR AIR QUALITY

COURSE OUTLINE: The course aims to explore the relationship between architectural form, materials and environmental performance, and how this relation should evolve in response to climate and emerging technical capabilities.

COURSE OBJECTIVES-

1. To familiarize students with impact of human behaviour and natural processes on buildings
2. To introduce design elements for passive modulation of building energy performance
3. To familiarize students with role of building materials in building energy performance
4. To introduce students to design principles for human comfort and healthy buildings.

COURSE OUTCOMES-On successful completion of the course students shall be able to

1. Describe and analyse impact of human behaviour and natural processes on buildings
2. gain familiarity with application of design elements for passive modulation of building energy performance
3. Describe and apply building materials for enhanced building energy performance
4. Gain familiarity with design principles for human comfort and healthy buildings.

UNIT I- Human Behaviour and Natural Influences- Atmospheric and thermal comfort, building performance, and occupant health, safety, and productivity. Factors responsible, energy systems for human comfort, PPD & PMV analysis. Micro and Macro thermal comfort scales – Interpreting Material data through Bio climatic charts Sun path, Passive strategies, solar heat gain, solar radiation, Stack effect, etc. Design Elements- Modifications of Architectural & Landscape Elements – Fenestration, roof, walls, flooring, trees and landscape.

UNIT II- Understanding the role of buildings and real estate assets and related emissions, Thermal Comfort in Buildings, Factors Affecting Thermal comfort in Buildings, Impact of Design of Buildings on Thermal Comfort.

UNIT III- Introduction to Indoor Air Quality (IAQ) in buildings, importance of maintaining proper IAQ. Characteristics associated with indoor air contaminants (IAC) are demonstrated, Source of pollutants, managing Air contaminants, resulting health effects, measurement techniques, mitigate and control measures of these IAQ.

UNIT IV- Energy Efficient HVAC Systems- Energy efficient HVAC, HVAC Matters, energy consumption of HVAC systems, types of HVAC systems, heating systems, ventilation systems, ventilation system controls. Design recommendations, Cooling load reduction measures, Energy recovery wheel. Different types of Energy-Efficient HVAC Systems Technologies and its working principles. Designing Energy Efficient HVAC Systems as per ASHRAE guidelines.

References:

1) Roger W. Haines, C. Lewis Wilson - HVAC system Design 4th Edition
2) Roy J. Dossat- Principles of Refrigeration - Pearson Education India
3) W.F.Stoecker- Refrigeration and Air Conditioning –McGraw Hill Publication
4) Ananthanarayanan- Refrigeration and Air Conditioning - Tata McGraw Hill Publication
5) A.L Hines, T.K. Gosh, S.K. Loyalka and R.C.Warder, Jr.-Indoor Air Quality & Control", PTR Prentice Hall (1993).
6) Richard A. Wadden, and Peter A. Scheff, Indoor Air Pollution - Characterization, Prediction, and Control, John Wiley & Sons (1983)

Sl.no.	Course	Category	Credits	Hours
6	Elective - II	Professional elective	3	3
a.	**Intelligent building systems**			
b.	Geo Informatics			
c.	MEP in design efficiency			

INTELLIGENT BUILDING SYSTEMS

COURSE OUTLINE- This course provides exposure on future trends of architecture and its practice, intelligent building systems, energy optimization strategies

COURSE OBJECTIVES-

1. Introduce the principles and systems for building automation
2. Familiarize students with building management systems
3. Introduce the role of Telecom networks in intelligent building design
4. Familiarize students with building automation subsystems

COURSE OUTCOMES- On successful completion of the course, students shall be able to-

1. Describe and apply the principles and systems for building automation
2. Describe and apply building management systems
3. Gain familiarity with the role of Telecom networks in intelligent building design
4. Acquire knowledge of building automation subsystems

UNIT I- Building Automation System- Intelligent building automation concept, Building automation system, Integration with building structures management system, Fire, security, maintenance, energy, characteristics and limitation, sensing system, intelligent building assessment. Technologies – field devices, digital, controllers, system controllers, man-machine interface, Sensors. Automation control strategies.
UNIT II – Building Management System- Methods to control, monitor, and optimise building services eg- lighting control system, heating and ventilation, climate control, security, CCTV, Alarm system, access control, Audio-Visual and entertainment system, lift control system,
UNIT III- Telecommunication Network – Various telecommunication, Automation control strategies, IoT, SCADA, BMS communication, protocol standard and OSI model, medium access schemes, different BMS network configuration, BACnet, integration at management level.
UNIT IV- Other Building Automation subsystem- Building security system, access control, cards access control, biometric access control, Lighting control system, fire detection system , lift control system, Control of CAV and VAV systems, outdoor ventilation control and optimization.

Books and References:

1. Intelligent Buildings: Design Management and Operation by Clements, Derek, Croome, Thomas Telford, Ltd.
2. Visionary Architecture: Unbuilt Works of the Imagination by Burden, Ernest, McGraw-Hill Professional.
3. Intelligent Building and Building Automation by ShengweiWang ,Spon press.

Sl.no.	Course	Category	Credits	Hours
6	Elective - II	Professional elective	3	3
a.	Intelligent building systems			
b.	**Geo Informatics**			
c.	MEP in design efficiency			

GEOINFORMATICS

COURSE OBJECTIVES-

1. To introduce students to the fundamentals of map preparation
2. To familiarize students with basics of remote sensing and aerial photogrammetry
3. To introduce students with basics and application of GPS
4. To impart skills in GIS software

COURSE OUTCOMES-On successful completion of the course students shall be able to

1. Describe and assimilate the fundamentals of map preparation
2. Gain familiarity with basics of remote sensing and aerial photogrammetry
3. Describe and assimilate basics and application of GPS
4. Acquire skills in GIS software

UNIT I Fundamentals of Maps

(Introduction, map reading, scale, types and sources, map co-ordinate systems and projections (Cylindrical, Conic, Azimuth), map preparation, visualization and guidelines of mapping)

UNIT II Aerial Photographs

(Introduction, geometry, scale, measurements, relief displacement, parallax, stereo photographs, height determination, visual interpretation)

Basics of remote sensing

UNIT III Global Position System

(Introduction, basic concepts, functions, data collection)

Introduction to Geographical Information System

(Introduction, concepts, features, data models, spatial data & non-spatial data, integration and analysis)

Introduction to GIS software

UNIT IV Geographical Information System software

Preparation of spatial maps using GIS software, Spatial analysis using tools and plugins

References

1. Burrough P.A. and McDonnell R.A. (1998) *Principles of Geographical Information Systems,* Oxford University Press, Oxford.
2. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
3. Heywood I., Cornelius S. and Carver S. (2006) *An Introduction to Geographical Information Systems,* Prentice Hall, 3rd edition.
4. *Jensen J.R. (2000) Remote Sensing of the Environment: An Earth Resource Perspective, Prentice Hall.*
5. Joseph G. (2003) *Fundamentals of Remote Sensing*, Universities Press, Hyderabad.
6. *Lillesand T.M., Kiefer R.W. and Chipman J.W. (2003) Remote Sensing and Image Interpretation, 5th ed., Wiley.*
7. Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (2005) *Geographic Information Systems and Science*, Chichester, Wiley, 2nd edition.

Sl.no.	Course	Category	Credits	Hours
6	Elective - II	Professional elective	3	3
a.	Intelligent building systems			
b.	Geo Informatics			
c.	**MEP in design efficiency**			

MEP IN DESIGN EFFICIENCY

COURSE OUTLINE: To introduce the demand side of energy and its approach in planning building services and management of the energy systems.

COURSE OBJECTIVES

1. Impart knowledge about Efficient HVAC systems for environmental architecture applications
2. Familiarize students with principles and applications of efficient electrical systems
3. Impart knowledge about efficient plumbing systems for buildings
4. Familiarize students with Green building parameters for MEP based on standards set by rating systems

COURSE OUTCOMES- On successful completion of the course, students shall be able to-

1. Describe and apply Efficient HVAC systems for environmental architecture applications
2. Gain familiarity with principles and applications of efficient electrical systems

3. Gain knowledge about efficient plumbing systems for buildings
4. Gain familiarity with Green building parameters for MEP based on standards set by rating systems

UNIT I – Efficient HVAC system - Introduction to basic concepts, Cooling Equipment - Central Plant Packaged Units - Zoning - Packaged Air-Conditioning Units – Absorption Units for Cooling - Ducts for Air Conditioning - Built-Up Air-Conditioning Units - Variable-Air- Volume (VAV) Systems - Air-Water Systems - Control Systems for Air Conditioning - Heating and Air Conditioning – Industrial -Air Conditioning - Chemical Cooling - Year-Round Air Conditioning - Energy efficiency techniques in air conditioning - Air conditioning in IT environments, hospitals etc., - Air conditioning for green buildings.

UNIT II – Efficient Electrical System - Electrical power , DC / Ac system, electrical load and emergency power , electrical conductors and raceways , electrical distribution in buildings , Substations , substation equipment's. power distribution system , standby and alternate power supply system, Light and sight , quality of light – lighting methods – daylight – system design of lighting. Measuring Light and Illumination ,selection of recommended Illuminance ,Zonal Cavity Method of Calculating Illumination, Lamp characteristics and Selection Guide –Impact of light on color , Integration of services , Electrical power monitoring, IBMS system

UNIT III- Efficient Plumbing system - Historical perspectives and Introduction to basic concepts, Different valves and their working principle, Equipment and their specifications, Low cost and green technologies, Pump types, factors affecting pump performance, efficient pump operation systems, flow control strategies. Energy conservation opportunities in pumping systems.

UNIT IV- Green building parameters for MEP- Methods of harvesting rainwater. Conserving water for making sustainable and resilient conditions. GRIHA and TERI standards. **Solar Energy**: Components, elements and working mechanism for electricity generation by solar panels. Advantages and disadvantages over conventional electricity generation. Passive solar techniques. Calculation for Solar Roofs, electricity generation and solar cities.

References:

1. Turner and Doty; Energy Management Handbook.
2. Jan Kreider; Solar heating design.
3. Green awareness, Ferris State University.
4. Shan Wang, Handbook of Air Conditioning and Refrigeration, 2n d Edition, McGraw Hill, 2000
5. 4. Krieder, J. F., Handbook of Heating Ventilation and Air Conditioning, Taylor & Francis, 2005
6. 5. Barrie Rigby, Design of Electrical Services for Buildings, 4th Edition, Routledge, 2013

Sl.no.	Course	Category	Credits	Hours
7	Advanced Digital tools & simulation software	Skill enhancement	3	3

ADVANCED DIGITAL TOOLS & SIMULATION SOFTWARE

COURSE OBJECTIVES -

1. Introduction to software Building information modelling tools like –Sefaira, Envi-met, Revit pulgins
2. Understanding the technological advancements of software simulation.
3. To integrate computer modeling tools with the 3D models.
4. To calibrate energy data through simulation model.

COURSE OUTCOMES- On successful completion of the course students shall be able to-

1. Demonstrate the best practice for analysis of 3D model.
2. To expose students to various evaluation tools used in various stages of design.
3. Visualize and createenergy analysis using plug ins
4. comprehend and prepare Digital design solution using the model.

UNIT I - **Introduction to interface** – Introduction to basics tools of Building Information Modeling Software.

UNIT II-Modeling: Building optimization models and Generate simulation of design variables.

UNIT III- **Visualize**:3D modeling interface as visualization tools.

UNIT IV- Simulations: analyse the performance and Integration of design response to existing buildings

References:

S.no	Description	Duration/No of visits	No of credits
1	**Training report- to include daily log and weekly reports signed by Office authority**	**16 working weeks**	**12**
2	**Site learnings and material study report with sketchbook/ software based simulation study reports**	**No of visits**	**02**
~~3~~	**published work of the previous sem design studio**		**02**

1. ENVI-met 3.1 Manual Contents
2. Advanced Technologies: Building in the Computer Age (The Information Technology Revolution in Architecture) by Valerio Travi

CURRICULUM SCHEME FOR III SEMESTER M. ARCH

PROFESSIONAL TRAINING

Sl.no.	Course	Category	Credits	Hours
1	Professional training	Employability enhancement	16	320
TOTAL			**16**	**320**

Professional training under an Architect registered with Council of architecture/ Enterprise specializing in environmental architecture envisages the following:

The students of Masters programme in Architecture (Environmental Architecture) are to undertake a practical training for a period of one semesters under a registered Architect or in the architectural wing/department of an organization working in the field of environmental architecture with senior Architects in its roll. The organization may be governmental, Private or non- governmental voluntary organizations namely CPWD State PWD Department or Board for Urban Planning, and NGO's involved in Housing, Urban development planning, or Environmental Planning under a senior Architect. Students are advised to select the firm keeping in mind the majority of the works should be in the realm of environmental architecture including design and certification of green buildings, eco architecture, vernacular architecture, alternative building techniques, environmental modeling and simulations etc.

1. The School shall scrutinize the Credentials of the training organization before permitting any student to take up the internship / practica1 training under that organization.
2. All Training organizations are requested to furnish the attendance and progress report every month to the School. A minimum of 80% of attendance at the Office for a period of 16 Calendar weeks is required for the students to qualify to register for the next semester.
3. After internship and practical training students are to submit the details of work or project in which they have involved. Report shall be submitted in written forms to the School along with a certificate from the employment along with copies of Drawings prepared.
4. The School at the end of the semester shall conduct the evaluation of the student's performance and achievement in the form of Viva Voce.

Distribution of Credits shall be as follows: Method of evaluation VIVA in presence of external Jury:
Rubrics will be shared with the students at the start of the semester

CURRICULUM SCHEME FOR IV SEMESTER M. ARCH

Sl.no.	Course	Credits	Hours
1	Thesis	12	6
2	Environment and energy Resource economics	3	3
TOTAL		15	**9**

DETAILED SYLLABUS FOR IV SEMESTER M. ARCH

ENVIRONMENTAL ARCHITECTURE THESIS

Thesis is a commonly used term to denote the final year culmination project carried out by students individually under the guidance of a team of mentors. Broadly speaking, thesis is a means of enquiry which is fulfilled by the students in collaboration with his/ her mentor/s. Thesis may be looked at an opportunity to emulate a real life architectural project in the realm of Environmental architecture.

COURSE OBJECTIVES-

1. To inculcate the capacity to focus and pursue a research/ design on the theme of environmental architecture through logical and methodical research process.
2. To facilitate the ability to design and execute a complex project with focus on environmental architecture
3. To inculcate skills necessary to communicate the design problem, its complexity and its proposed solutions along with detailed analysis using software/ material explorations/ alternative techniques etc.
4. To inculcate confidence in students to carry out projects independently and develop the ability to convincingly defend their propositions.

COURSE OUTCOMES

1. Acquire a deeper insight into the chosen topic of interest through research and critical thinking.
2. Apply the fundamental knowledge of theoretical, technical and professional expertise gained to address environmental issues through the chosen topic.

Sl.no.	Course	Category	Credits	Hours
1	Environmental architecture Thesis		12	6

3. Demonstrate creative and technical abilities to deliver design solutions in the realm of environmental architecture
4. Interpret the design and learnings by demonstrating effective visual, written and verbal communicative skills through the final output of drawings, models & presentations

Research versus Design

Architects often pride themselves on carrying out in-depth research to complete the design. Both research and design are complimentary to each other if carried out in a logical and methodical manner. While research is expected to broaden the understanding of the issue identified, design helps us in finally arriving at a creative and innovative solution. Students are advised to maintain a balance between the two components keeping the following in mind-

1. Students who are keen on design focussed thesis may opt for 70-30 mix of
1. design and research components in their thesis
2. Students who are keen of research focussed thesis may opt for a 60-40 mix of research and design components in their thesis.
3. Apart from the above a hybrid 50-50 approach with equal emphasis of design as well as research is also acceptable
4. The student must discuss the design-research mix at the outset with his/her thesis advisor.

Thesis Deliverables-

1. Thesis report in specified format consisting of Issue identification, pre design research work, description of design solution and proposals.

2. Sheet panel composed of scaled architectural drawings and other material necessary to explain the premise and the solutions
3. An oral presentation to a panel of examiners

Sl.no.	Course	Category	Credits	Hours
2	Environment and energy Resource economics	Professional core	3	3

ENVIRONMENT AND ENERGY RESOURCE ECONOMICS

COURSE OBJECTIVES -

1. Understanding the Economics of Environmental development
2. Knowledge of economic tools to describe the production and consumption of energy.
3. Describes the impacts of energy systems.
4. Assess the issues in energy economics and policy.

COURSE OUTCOMES- On successful completion of the course students shall be able to-

1. Familiar with the concepts of Environmental Economics
2. Understanding welfare of energy resources and environmental economics
3. To equip the students achieving economic efficiency within these systems.
4. Evaluation of economic approaches and other real-world problems.

UNIT I – **Introduction to Environmental Economics:** Fundamentals of Environmental Economics, Basic Theory of Environmental Economics, Natural Resource Economics.

UNIT II- **Energy Economics**: Energy and Quality of Life, Global Trends in Energy Use, Resources & Reserves Growth Rates in Consumption, Estimates of Duration of Fossil Fuels

UNIT III- **Energy Analysis:** Cost benefit analysis of raw material, technology used and finished building (Primary Energy Analysis, Net Energy Analysis, Examples, Energy Cost of Energy, Life Cycle Analysis of Bioenergy)

UNIT IV- **Energy Policy:** Case Studies Examples, modelling of energy systems, energy planning and policy

References

1. Bottomore ,T.B.P.Goode(eds) readings in Marxist Sociology, Oxford, Part 1City and Grassroots: A Cross Cultural Theory of Urban Social Movements ,London
2. Growth Economics by Amartya Sen.
3. Economic and social development by S.L.Sinha
4. Martin Gerald (2001): Human Ecology - Basic Concepts for Sustainable Development, Routledge, London