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Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Prof. K. R. Sundararajan, a well-known educationalist, established the Indian Institute of Engineering Technology (I.I.E.T) society in the year 1947 in Chennai. The total area of 14 acres was purchased with enormous hardship and was donated to the IIET Society for the cause of education. The society's main objective is to provide quality education and it has been ensured since 1951.

The IIET Society has the following to its credit :-

- An uninterrupted and continuous education since 1951 in its premises
- All Colleges run by the institution are ranked among the top 5 top 10 programs in Tamil Nadu
- 350 KW Solar Power Plant Generating upto 70% of its electricity needs
- Significant portion of the students are first generation learners
- Campus holds approximately 7000 plus students from the ages of 4 to 35 plus.
- Large Green Campus in the heart of the city of Chennai, Tamil Nadu
- In existence since 1947 Completed 75 years
- Targeting to be Carbon Neutral from the end of the year 2025

The society currently has the following institutions :-

- Meenakshi Sundararajan Engineering College(MSEC) established in 2001 & affiliated to Anna University offering engineering programs with about 2000 plus students.
- Meenakshi Sundararajan School of Management(MSSM) established in 2000 & affiliated to University of Madras offering MBA programs with about 100 plus students.
- The NEST School (TNS)- established in 2022 offering IB (International Baccalaureate) & CAIE (Cambridge) boards.

All of the institutions have earned an enviable name and are rated as one among Top 10 colleges in the Tamil Nadu state in their respective programs. Efforts are on to make the campus carbon neutral in 2 years (end of 2025) by using our community of staff and students.

Meenakshi Sundararajan Engineering College (MSEC) was established by the IIET Society in 2001. MSEC is defined by two keywords "Industry Ready" & "Vibrancy". Creating a new generation of self- actualized learners is our raison d'etre. If children are our future, then education is the key to their future. When education is shaped around them, and not the other way around, we are laying the foundation for a future/world where creativity, diversity and caring, independent-thinkers thrive. Our curricula thrive on continuous learning while interacting with and incorporating real-world situations and challenges.

MSEC's Hallmark of Quality

- Affiliated to Anna University, Chennai
- Approved by AICTE, New Delhi
- Accredited by NBA for programs in:
 - Civil Engineering
 - Computer Science and Engineering
 - Electronics and Communication Engineering
 - Mechanical Engineering
 - Electrical and Electronics Engineering
 - Information Technology
- Accredited by NAAC with a prestigious "A" grade
- Declared under Section 2(f) and 12(B) of the UGC Act
- Conferred with Autonomous status for 10 years (2024-25 to 2033-34) by the University Grants Commission (UGC) on February 1, 2024
- Meenakshi Sundararajan Innovation and Incubation Centre (MSIIC)
- Meenakshi Sundararajan Career Development Cell (MSCDC)
- MSEC Research Centre (MSEC RC)
- Center of Excellence Industry Tie Up in Specialized Labs
- Industry MOU's 200 Plus

Vision of the Institute

To impart state-of-the-art technical education, including sterling values and shining character, producing engineers who contribute to nation building thereby achieving our ultimate objective of sustained development of an unparalleled society, nation and world at large.

Mission of the Institute

Meenakshi Sundararajan Engineering college, Chennai constantly strives to be a Centre of Excellence with the singular aim of producing students of outstanding academic excellence and sterling character to benefit the society, our nation and the world at large.

To achieve this, the college ensures

- Continuous upgradation of its teaching faculty to ensure a high standard of quality education and to meet the ever-changing needs of the society
- Constant interaction with its stakeholders
- Linkage with other educational institutions and industries at the national and international level for mutual benefit
- Provision of research facilities and infrastructure in line with global trends
- Adequate opportunities and exposure to the students through suitable programs, to mould their character and to develop their personality with an emphasis on professional ethics and moral values.

We offer following courses:

S.No	Course	Intake					
	Undergraduate courses in B.E / B. Tech						
01	B.E Civil Engineering	60					
02	B.E Computer Science and Engineering	120					
03	B.E Electronics and Communication Engineering						
04	B.E Electrical & Electronics Engineering						
05	B.E Mechanical Engineering						
06	B. Tech Information Technology	120					
07	B. Tech Artificial Intelligence & Data Sciences	120					
	Postgraduate courses in M.E / M. Tech						
08	M.E. Construction Engineering and Management	18					
09 M.E. Computer Science and Engineering							
10	M.E. Embedded System Technologies	18					
11	M.E Energy Engineering	18					

DEPARTMENT OF HUMANITIES AND SCIENCE

The H&S Department stands out for its commitment to providing a well-rounded academic experience for first-year students. Covering key subjects like Physics, Chemistry, Mathematics, English, and Tamil. The department boasts a high pass percentage in semester exams, a testament to the hard work and dedication of the faculty. This year, the department enhanced offerings with industry and alumni talks, foreign language courses, engaging games, and specialized coaching for AEP and ICS. Additionally, the department introduced an industry-oriented and department-specific syllabus to better prepare students for future challenges and opportunities

DEPARTMENT OF CIVIL ENGINEERING

The Civil Engineering Department at our college, established in 2002, is a beacon of academic excellence and research innovation. Offering both undergraduate program and postgraduate program in M.E. Construction Engineering and Management, the department is committed to integrating advanced technologies and sustainable practices into its curriculum. The department boasts state-of-the-art laboratories and strong industry collaborations. Graduates of the department have made significant contributions to civil engineering, both nationally and internationally, and continue to shape the future of the discipline through unwavering commitment to excellence.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

The Department of Computer Science and Engineering was established in 2001. It has its mission to inculcate innovative thinking and analytical abilities in addition to imparting quality education in the theory and application of Computer Science and Engineering. The department offers UG and PG programmes with State-of-the-art Computer laboratories equipped with high end hardware and software packages provided with high-speed leased line connectivity. The department takes pride in its academic excellence and outstanding placement records. It has consistently produced 68 university rank holders till 2023 batch and accredited by National Board of Accreditation.

DEPARTMENT OF

ELECTRICALAND ELECTRONICS ENGINEERING

The Electrical and Electronics Engineering Department, established in 2003, is expanding its offerings to M.E. program in Embedded System Technologies from the 2024-25 academic year. With a focus on knowledge - based training, the department faculty empowers students with a deep understanding of concepts and industry - ready skills. The department forged partnerships with 22 companies through MOUs, facilitating collaboration and knowledge exchange.

The Electrical Technocrats Association (ETA) is a vibrant platform for technical activities, including the publication and showcasing of newsletters by staff and students every fortnight. Our mission is to drive technological advancements, foster research, and address industry needs.

DEPARTMENT OF MECHANICAL ENGINEERING

Meenakshi Sundararajan Engineering College inaugurated the Department of Mechanical Engineering in the academic year 2011-12. The department has well qualified faculties with excellent teaching, training and industrial experience. It has state-of-the-art laboratories which include VMC, CNC Wire Cut, Spark Erosion, 3D CMM etc catering to academic, consultancy and research requirements. The department's endeavor is to develop its students to be industry ready when they graduate. Students of mechanical engineering department gain industrial exposure and are prepared to face future challenges by carrying out their Final Year Project work in various PSU/Private sectors as per their field of interest relevant to their program. The department has a memorandum of understanding with various Institutions, Industries and Research organizations for collaborative research and development work. There is a huge potential in the department for Consultancy as well as Technology and Product incubation.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

The Department of Electronics and Communication Engineering, established in 2001, has grown significantly increasing its sanctioned intake from 60 to 120 in 2010. With NBA accreditation, the department is committed to delivering quality education, producing graduates who excel technically, socially, and professionally. Its state-of-the-art infrastructure, featuring ICT-enabled classrooms and advanced laboratories with cutting-edge tools like Cortex M4, Spartan 6, IoT kits, MATLAB, Cadence and PSPICE that supports academic excellence.

The Department's industry linkages with renowned organizations including ISRO, DRDO, NLTVC, and Ericson enhance students' technical skills through interactive events.

The Department's achievements include academic excellence, impressive placement records, and students' accomplishments in sports, arts, and culture, with alumni globally represented in top companies like Intel, Yahoo, and Apple.

DEPARTMENT OF INFORMATION TECHNOLOGY

The department of Information Technology was started in the year 2001 with an intake of 60 students focusing on the area. The department has won laurels to to the college. The department constantly strives with the singular aim of producing students with outstanding academic excellence and sterling character to benefit the society, our nation and the world at large. The department's commitment to high academic standards and successful student placements. It has consistently produced 65 university rank holders till 2023 batch and accredited by National Board of accreditation. Campus Agreement has been signed with leading software and hardware giants like Microsoft, IBM, Adobe and HP. The department has received a certificate partnership as a "Center of Excellence" with Virtusa Technology.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

The Department of Artificial Intelligence & Data Science was established in 2021 with an initial intake of 60 students, which was subsequently increased to 120 in 2024. Our department boasts a team of highly qualified, experienced, and competent faculty members and features spacious infrastructure with modern amenities, including six well-equipped computer laboratories with backup and internet facilities. We emphasize continuous knowledge enrichment through seminars, guest lectures, workshops, and skill enhancement programs for both students and faculty, and engage in meticulous academic planning to ensure a well-structured approach to each semester. Additionally, our student-driven club, serves as an incubation center, nurturing innovative ideas and fostering creativity.

INTERNAL QUALITY ASSURANCE CELL (IQAC)

MSEC established the Internal Quality Assurance Cell (IQAC) in 2016 to develop and implement quality standards and benchmarks in key performance areas. In alignment with the National Education Policy (NEP) 2020 and subsequent reforms, the IQAC has been further strengthened to ensure compliance with the new policy directives.

Through IQAC, the institute strive to:

- Maintain and enhance the quality of education and services
- Align with our institution's vision and mission
- Foster a culture of continuous improvement and excellence
- Ensure accountability and transparency in institutional functioning
- Promote innovative practices in teaching, learning, and research
- Develop and implement effective quality benchmarks and parameters
- Facilitate student-centered learning and feedback mechanisms
- Enhance faculty development and capacity building
- Strengthen industry-academia partnerships and collaborations
- Ensure efficient governance and administrative processes
- Promote a culture of sustainability and social responsibility
- Facilitate accreditation and ranking processes
- Identify and mitigate quality assurance risks

CONTROLLER OF EXAMINATION

The institution, granted autonomous status by UGC and Anna University from the academic year 2024-2025, has established the Controller of Examinations (COE) office to oversee assessment processes with confidentiality, ensuring quality and standards. The COE conducts fair examinations, declares results, and manages examination activities for Internal Assessment Tests (IATs) and Semester End Examinations (SEE). Their yearly schedule includes planning, coordinating, conducting, evaluating, and reviewing exams, as well as issuing certificates and transcripts. The COE ensures smooth conduct, maintains exam integrity, and coordinates with stakeholders, adapting to the institution's specific needs and exam cycle.

MEENAKSHI SUNDARARAJAN RESEARCH CENTRE(MSRC)

The MSEC Research Centre has a steadfast commitment to fostering a strong research culture. It empowers students and faculties in their intellectual exploration and discovery. The center aims to advance knowledge, drive neoteric innovation, and contribute to the broader academic and industrial fraternity ultimately aimed at uplifting humankind.

THE MEENAKSHI SUNDARARAJAN CAREER DEVELOPMENT COMMITTEE (MSCDC)

The Meenakshi Sundararajan Career Development Committee (MSCDC) is a strategic group dedicated to fostering students' professional growth and development. Our mission is to support students in achieving their career goals, fostering a culture of professional growth and development.

The MSCDC plays a vital role in aligning individual career goals through various initiatives, including:

- 1. Career Pathways
- 2. Specialised Expert Talk & Guidnace on Different Career Pathways
- 3. Higher Education Awareness Sessions on various Geographical Locations
- 4. University Fairs
- 5. Training / Coaching Programs for different Competitive Exams
- 6. Repository / Text Books for various Competitive Exams

By providing a career pathway, we help students understand the opportunities available to them and what is required to achieve their career goals. We encourage students as they navigate their professional journey, providing them with the tools, knowledge, and opportunities needed for successful career development.

OFFICE OF STUDENTS AFFAIRS

Our mission is to create a supportive and inclusive educational environment that empowers students to succeed in their academic, personal, and professional lives. We achieve this by:

- Providing individualized support and responding to student needs
- Fostering a culture of academic integrity and excellence
- Promoting personal hygiene, cleanliness, discipline and sprucing
- Encouraging a moral code of conduct and respect for others
- Cultivating a sense of campus decency and decorum
- Modeling exemplary behavior and attitudes

By fulfilling these responsibilities, the institution aims to inspire students to become responsible, successful, and compassionate individuals who make a positive impact in their communities.

COLLEGE COUNSELING SERVICES

College counseling services are essential in supporting students' overall well-being and academic success. These services often encompass various areas, including healthy mind well-being, career guidance, and academic counseling. Here's a breakdown of the typical counseling services available for college students in the institution: **Individual Counseling:** One-on-one sessions with RCI registered counselors or psychologists to address personal issues such as stress, anxiety, depression, relationship problems, and any other psychological concerns.

Group Counseling: Support groups where students with similar issues can share experiences and strategies for coping in a safe and supportive environment.

Crisis Intervention: Immediate support for students in distress, trauma response, and any emergency psychological concerns.

TRAINING AND PLACEMENT CELL

Meenakshi Sundararajan Engineering College training and placement cell is committed to providing exceptional placement opportunities for its students. The Placement Cell takes meticulous efforts to ensure that students are recruited by topnotch companies in the industry.

The training pathway is established starting from the first semester with 180 Hours of Placement training which includes Communications Skills, Aptitude Training. Specialised Programming, Guidance on Certifications, Projects, Competitions, Grooming, Etiquette, Group Discussion and Mock Interviews.

The Placement Cell functions under the leadership of Placement Officer, Faculty representatives and Coordinators from each department. The Cell's ultimate aim is to achieve 100% placement. Its Other Functions include

- 1. Implementation of the training pathway at appropriate semesters
- 2. Industry Talks
- 3. Alumni Talks
- 4. Arranging Internships & Projects
- 5. Centers of Excellence with Industry
- 6. Industry Specialised training & guidance

This comprehensive training empowers students to face the campus interviews with confidence through enhancing their employability skills for a successful future.

DEPARTMENT OF PHYSICAL EDUCATION

Our college campus boasts an array of sports facilities, including

- Basketball Court
- Badminton Court
- Pickle Ball Court
- Volleyball
- Cricket/FootBall/AthleticsGround
- Tennis Court
- Kho Kho

The institution is much dedicated in nurturing the talent through specific college sports teams :

- Expert coaching and mentorship
- Formation of new sports teams
- Dedicated Sports Hour (1 hour/week)
- Regular Sports Day events that are meticulously planned for maximum student participation.

DEPARTMENT OF SAFETY AND SECURITY

MSEC's Safety Department include the Chief Security Officer (Retd. Lt. Col), Trained & Certified Safety Officers (18) and Chief Safety Officer.

The department ensures a secure and hazard-free environment within the campus through:

- Monitoring all areas of the campus to ensure a secure environment
- Conducting daily reviews and maintaining a register to track and address any safety issues
- Performing maintenance tasks such as securing compound walls, replacing damaged fencing, and ensuring proper drainage
- Educating the community through regular safety awareness programs and training sessions
- Organizing fire drills and evacuation procedures to prepare for emergencies
- Identifying and mitigating potential hazards to prevent accidents
- Developing and implementing comprehensive safety policies to guide the community
- Continuously monitoring CCTV cameras to quickly respond to any security incidents

The department's proactive approach helps to prevent accidents, minimizes risks, and fosters a culture of safety among students, staff, and faculty members.

MEENAKSHI SUNDARARAJAN INNOVATION AND INCUBATION CENTRE (MSIIC)

Meenakshi Sundararajan Innovation and Incubation Centre (MSIIC) is a dynamic and forward-thinking organization dedicated to fostering innovation, entrepreneurship, and skill development etc. Our center serves as a catalyst for a transformative change - providing aspiring entrepreneurs with the resources, mentorship, and support that is needed to turn their ideas into successful ventures. MSIIC is dedicated to promoting entrepreneurship and an innovative mindset among students and entrepreneurs at institutions. Through mentorship MSIIC helps to develop talents and support their initiatives, provide knowledge on market access and funding, and empower individuals to identify opportunities, take risks, and create positive change. The institution solely believes in entrepreneurship as a catalyst for innovation and societal impact, providing resources and a supportive environment for individuals to thrive and make a difference in their communities and beyond. Its activities include

- 1. Managing the 100 Seat Innovation & Incubation Center
- 2. Guidance to both Internal & External Start-ups from Ideation to Funding
- 3. Competitions-Identification & Mentoring
- 4. Conducting Competitions :- 30 Hour Hackathons, All India Hackathons etc.
- 5. Managing Student Clubs
- 6. Art & Music Festival
- 7. Skill Development / Value Added Courses
- 8. Societal Beneficial Projects

MSEC STUDENTS CLUBS

MSEC Students Clubs were initiated with the objective to provide a platform for students to discover, showcase and improve their interests, strengths and passion. There are 7 clubs in our college namely, AI Epoch Club, Eco Design Club, Adyant Coding Club, Renewables Club, Nodenova IOT Club, Dev Dynasty Web App Development Club and Product Development Club. Clubs foster vibrant student community in the campus by conducting variety of events and activities which include workshops, seminars, technical and non-technical events, campus benefit projects, long term projects such as SAE Baja etc that cater to diverse interests. Clubs help the students to collaborate with different disciplines and exchange knowledge with peer groups.





	Vision of the department	Mission of the department
To de challen excelle training	velop technical man power by facing ges in emerging technologies through nce in education, research and scientific with socio-economic involvement.	 Transcending, disseminating and integrating knowledge of engineering, science and technology. Developing and innovating in applications through interdisciplinary research and development projects in collaboration with stakeholders. Acting as problem solvers by acquiring relevant skills required for a wide range of career challenges. Creating opportunities in a collaborative and sustainable environment and encouraging students and staff to achieve the best.
	PROGRAM OUTCOMES (PO) and PR	OGRAM SPECIFIC OUTCOME (PSO)
PO1	Research Aptitude An ability to independer development work to solve practical proble	ntly carry out research / investigation and ms.
PO2	Technical Documentations An ability report/document.	to write and present a substantial technical
PO3	Technical Competence Students should be area as per the specialization of the progra the requirements in the appropriate bache	e able to demonstrate a degree of mastery over the imme. The mastery should be at a level higher than lor programme.
PO4	Critical Analysis of Construction Manage Construction Engineering-related problems information.	ement-related Problems Critically analyse complex s and apply independent judgment for synthesizing
PO5	Conceptualization and Evaluation of In Management Issues Conceptualize and s evaluate potential solutions and arrive environmentally sound solutions with due factors.	novative Engineering Solutions to Construction solve Construction Management-related problems, at technically feasible, economically viable and consideration of health, safety and socio-cultural
PO6	Life-long Learning Recognize the need emerging technologies in Construction Eng	for independent, life-long learning and adapt to ineering and solutions to novel problem
PSO1	Demonstrate expertise in modern adva technology, and composite materials, wit practical applications.	ancements in construction technology, concrete th a strong understanding of their properties and
PSO2	Excel in careers related to construction m address diverse challenges in the construction	anagement by applying fundamental principles to tion industry effectively.
PSO3	Design and implement sustainable, cost-e societal and environmental concerns while	ffective solutions with a thorough understanding of upholding professional ethics.



Mapping of Course Outcomes and Programme Outcomes

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6
		Statistical Methods for Engineers	1.6	0.8	2.6	-	-	-
	_	Modern Construction Materials	3	1	2	2	1	3
	2	Project Formulation and Appraisal	2	1	3	3	1	2
_	μ	Construction Equipment and Management	3	1	2	3	2	3
Ř	ST	Professional Elective I	-	-	-	-	-	-
▼	AE	Research Methodology and IPR	-	-	-	-	-	-
Υ	Ē	Audit Course - I	-	-	-	-	-	-
	S	Advanced Construction Engineering and	2	2	3	3	1	2
		Experimental Techniques Laboratory	2	2	0			
		Technical Seminar	2	3	2	3	2	3
		Advanced Construction Techniques	3	1	3	3	2	3
	2	Construction Planning, Scheduling and Control	3	1	3	3	2	3
	Ш	Contract Laws and Regulations	2	1	3	3	3	2
	ST	Professional Elective II	-	-	-	-	-	-
	Ϊ	Professional Elective III	-	-	-	-	-	-
	Ш	Audit Course -II	-	-	-	-	-	-
	S	Construction Management Studio Laboratory	2	2	3	3	3	3
		Statistical Analysis for Construction Engineers	3	3	3	3	3	3
		Professional Elective IV	-	-	-	-	-	-
	E S	Professional Elective V	-	-	-	-	-	-
	Ш	Open Elective	-	-	-	-	-	-
	LS:	Practical Training (4 weeks)	3	3	3	3	2	2
S II	SEME	Project Work I	3	3	3	3	3	3
YEAR	SEMESTER IV	Project Work II	3	3	3	3	3	3



PROFESSIONAL ELECTIVE COURSES (PEC)

S. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
1.	Advanced Concrete Technology	3	1	3	2	2	2
2.	Human Resources Management in Construction	2	1	3	3	3	3
3.	Construction Project Management	3	1	3	3	2	2
4.	Sustainable Construction	3	1	З	2	З	2
5.	Economics and Finance Management in Construction	3	1	3	3	3	1
6.	Design of Energy Efficient Buildings	3	1	3	3	2	3
7.	Project Safety Management	3	2	3	2	1	2
8.	Computer Applications in Construction Engineering and Planning	3	1	3	2	2	2
9.	Quantitative Techniques in Management		1	3	3	1	1
10.	Resource Management and Control in Construction		1	3	3	2	2
11.	Shoring, Scaffolding and Formwork	3	1	3	2	1	1
12.	System Integration in Construction	3	1	3	3	2	3
13.	Advanced Data Analysis	3	1	3	3	2	3
14.	Lean Construction Concepts, Tools & Practices	3	1	3	3	2	2
15.	Environmental Impact Assessment For Construction Engineers	3	2	3	3	2	3
16.	Maintenance, Repair and Rehabilitation of Structures		1	3	2	2	1
17.	Quality control and assurance in construction	3	1	З	З	2	2
18.	Organizational Behaviour	3	1	3	2	3	2
19.	Digital Design and Construction	3	1	3	3	2	3
20.	Supply chain management and Logistics in construction	3	1	3	3	2	3



SEMESTER I

S.	COURSE	COURSE TITLE	CATE-	PE PER	rioi We	DS EK	TOTAL CONTACT	CREDITS
NO.	CODE		GORT	L	Т	Ρ	PERIODS	
THE	ORY							
1.	P24MA101	Statistical Methods for Engineers	FC	4	0	0	4	4
2.	P24CN101	Modern Construction Materials	PCC	3	0	0	3	3
3.	P24CN102	Project Formulation and Appraisal	PCC	3	1	0	4	4
4.	P24CN103	Construction Equipment and Management	PCC	3	0	0	3	3
5.	P24RM101	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Professional Elective I	PEC	3	0	0	3	3
7.		Audit Course I*	AC	2	0	0	2	0
PRA	CTICALS							
8.	P24CN104	Advanced Construction Engineering and Experimental Techniques Laboratory	PCC	0	0	4	4	2
9.	P24CN105	Technical Seminar	EEC	0	0	2	2	1
		•	TOTAL	20	1	6	27	22

* Audit Course is optional

SEMESTER II

S	COURSE	COURSE TITLE	CATE-	PE PEF	RIO R WE	DS EK	TOTAL CONTACT	CREDITS
NO.	CODE		GORT	L	Т	Ρ	PERIODS	
THE	ORY							
1.	P24CN201	Advanced Construction Techniques	PCC	3	0	0	3	3
2.	P24CN202	Construction Planning, Scheduling and Control	PCC	3	0	0	3	3
3.	P24CN203	Civil Contract and Regulations	PCC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRA	CTICALS							
7.	P24CN204	Construction Management Studio Laboratory	PCC	0	0	4	4	2
8.	P24CN205	Statistical Analysis for Construction Engineers Laboratory	PCC	0	0	4	4	2
			TOTAL	17	0	8	25	19

* Audit Course is optional



SEMESTER III

S	COURSE	COURSE TITLE	CATE-	PERIODS PER WEEK			TOTAL CONTACT	CREDITS			
	OODE		CONT	L	Т	Ρ	PERIODS				
THE	THEORY										
1.		Professional Elective IV	PEC	3	0	0	3	3			
2.		Professional Elective V	PEC	3	0	0	3	3			
3.		Open Elective	OEC	3	0	0	3	3			
PRA	CTICALS										
4.	P24CN301	Practical Training (4 Weeks)	EEC	0	0	0	0	2			
5.	P24CN302	Project Work I	EEC	0	0	12	12	6			
			TOTAL	9	0	12	21	17			

SEMESTER IV

S.	COURSE	COURSE TITLE	CATE-	PERIODS PER WEEK			TOTAL CONTACT	CREDITS
NO.	CODE	DE GORT		L	Г	Ρ	PERIODS	
PRA	CTICALS							
1.	P24CN401	Project Work II	EEC	0	0	24	24	12
			TOTAL	0	0	24	24	12

TOTAL CREDITS: 70

FOUNDATION COURSES (FC)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER	
			L	Т	Р			
1.	P24MA101	Statistical Methods for Engineers	4	0	0	4	1	

PROFESSIONAL CORE COURSES (PCC)

S	COURSE	COURSE TITLE	P	PERIC PER W	DDS /EEK	CREDITS	SEMESTER
NO.	CODE		L	Т	Ρ		
1.	P24CN101	Modern Construction Materials	3	0	0	3	1
2.	P24CN102	Project Formulation and Appraisal	3	1	0	4	1
3.	P24CN103	Construction Equipment and Management	3	0	0	3	1
4.	P24CN104	Advanced Construction Engineering and Experimental Techniques Laboratory	0	0	4	2	1
5.	P24CN201	Advanced Construction Techniques	3	0	0	3	2
6.	P24CN202	Construction Planning, Scheduling and Control	3	0	0	3	2
7.	P24CN203	Contract Laws and Regulations	3	0	0	3	2
8.	P24CN204	Construction Management Studio Laboratory	0	0	4	2	2
9.	P24CN205	Statistical Analysis For Construction Engineers	0	0	4	2	2
		-	DITS	25			



LIST OF PROFESSIONAL ELECTIVE COURSES [PEC]

SEMESTER I, ELECTIVE I

S. NO.	S. COURSE COURSE TITLE		P PE	erio Er We	DS EEK	TOTAL CONTACT	CREDITS
			L	Т	Ρ	PERIODS	
1.	P24CN501	Advanced Concrete Technology	3	0	0	3	3
2.	P24CN502	Human Resources Management inConstruction	3	0	0	3	3
3.	P24CN503	Construction Project Management	3	0	0	3	3
4.	P24CN504	Sustainable Construction	3	0	0	3	3

SEMESTER II, ELECTIVE II

S.	S. COURSE COURSE TITLE		PI PE	erioi R We	DS EK	TOTAL CONTACT	CREDITS
110.	OODL		L	Т	Ρ	PERIODS	
1.	P24CN505	Economics and Finance Management in Construction	3	0	0	3	3
2.	P24CN506	Design of Energy Efficient Buildings	3	0	0	3	3
3.	P24CN507	Project Safety Management	3	0	0	3	3
4.	P24CN508	Computer Applications in Construction Engineering and Planning	3	0	0	3	3

SEMESTER II, ELECTIVE III

S. NO		COURSE TITLE	P PE	erioi R We	DS EK	TOTAL CONTACT	CREDITS
			L	Т	Ρ	PERIODS	
1.	P24CN509	Quantitative Techniques in Management	3	0	0	3	3
2.	P24CN510	Resource Management and Control in Construction	3	0	0	3	3
3.	P24CN511	Shoring, Scaffolding and Formwork	3	0	0	3	3
4.	P24CN512	System Integration in Construction	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S.	COURSE	COURSE TITLE	PI PE	eriod R We	DS EK	TOTAL CONTACT	CREDITS
	CODL		L	Т	Ρ	PERIODS	
1.	P24CN513	Advanced Data Analysis	3	0	0	3	3
2.	P24CN514	Environmental Impact Assessment For Construction Engineers	3	0	0	3	3
3.	P24CN515	Lean Construction Concepts, Tools and Practices	3	0	0	3	3
4.	P24CN516	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	3



SEMESTER III, ELECTIVE V

S.	COURSE	COURSE TITLE	PE PE	ERIOD R WEE	S EK	TOTAL CONTACT	CREDITS
110.	OODL		L	Т	Р	PERIODS	
1.	P24CN517	Quality Control and Assurance in Construction	3	0	0	3	3
2.	P24CN518	Digital Design and Construction	3	0	0	3	3
3.	P24CN519	Organizational Behaviour	3	0	0	3	3
4.	P24CN520	Supply Chain Management and Logistics in Construction	3	0	0	3	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S.	COURSE	COURSE TITLE	PE PE	eriod R We	DS EK	CREDITS	SEMESTER
NO.	CODL		L	Т	Ρ		
1.	P24RM101	Research Methodology and IPR	2	0	0	2	1
			TOTAL		DITS	2	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.	COURSE	COURSE TITLE	F P	Period Er We	DS EK	CREDITS	SEMESTER
NO.	CODE		L	Т	Р		
1.	P24CN105	Technical Seminar	0	0	2	1	1
2.	P24CN301	Practical Training (4 weeks)	0	0	0	2	3
3.	P24CN302	Project Work I	0	0	12	6	3
4.	P24CN401	Project Work II	0	0	24	12	4
			тот	ALCRE	DITS	21	

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S.	COURSE	COURSE TITLE	P	PERIOD ER WEE	S EK	CREDITS	SEMESTER
NO.	CODE		Lecture	Tutorial	Practical		
1.	P24AC01	English for Research Paper Writing	2	0	0	0	
2.	P24AC02	Disaster Management	2	0	0	0	1/2
3.	P24AC03	Constitution of India	2	0	0	0	
4.	P24AC04	நறறம ிழ இலகக ியம	2	0	0	0	



LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

ei	COURSE		PEF	RIODS	PER	
SL.	CODE	COURSE TITLE		WEEK	CREDITS	
NO.	CODE		L	Т	Ρ	CREDITS
1.	P24EM133	Smart Grid	3	0	0	3
2.	P24OC517	Security Practices	3	0	0	3
3.	P24OC518	Cloud Computing Technologies	3	0	0	3
4.	P24OC519	Design Thinking	3	0	0	3
5.	P24OC520	Principles of Multimedia	3	0	0	3
6.	P24OC521	Block chain Technologies	3	0	0	3
7.	P240C522	Deep Learning	3	0	0	3
8.	P24OE513	IoT for Smart Systems	3	0	0	3
9.	P240E514	Machine Learning and Deep Learning	3	0	0	3
10.	P24OE515	Renewable Energy Technology	3	0	0	3
11.	P240M523	Vibration and Noise Control Strategies	3	0	0	3
12.	P24OM524	Energy Conservation and Management in Domestic Sectors	3	0	0	3
13.	P24OM525	Additive Manufacturing	3	0	0	3
14.	P24OM526	Electric Vehicle Technology	3	0	0	3
15.	P24OM527	New Product Development	3	0	0	3
16.	P24OT501	Sustainable Management	3	0	0	3
17.	P24OT502	Micro and Small Business Management	3	0	0	3
18.	P24OT503	Intellectual Property Rights	3	0	0	3
19.	P24OT504	Ethical Management	3	0	0	3
20.	P24OT505	Big Data Analytics	3	0	0	3
21.	P24OT506	Internet of Things and Cloud	3	0	0	3
22.	P24OT507	Medical Robotics	3	0	0	3
23.	P24OT508	Embedded Automation	3	0	0	3
24.	P24OT509	Environmental Sustainability	3	0	0	3
25.	P24OT510	Textile Reinforced Composites	3	0	0	3
26.	P24OT511	Nanocomposite Materials	3	0	0	3
27.	P24OT512	IPR, Biosafety and Entrepreneurship	3	0	0	3



S.	Name of the Progra	mme: N N	I.E CO MANAG		TION ENG	INEERING AND
NO.	SUBJECT AREA	CRE	DITS F	PER SEN	NESTER	CREDITS TOTAL
			II		IV	
1.	FC	04	00	00	00	04
2.	PCC	12	13	00	00	25
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	01	00	08	12	21
7.	Non Credit/ Audit Course	\checkmark	~	00	00	
	TOTAL CREDITS	22	19	17	12	70

SUMMARY



P24MA101 STATISTICAL METHODS FOR ENGINEERS L

L	Т	Ρ	С
4	0	0	4

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OBJECTIVES :

• This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis, correlation and regression, design of experiments and multivariate analysis.

UNIT I ESTIMATION THEORY

Estimators : Unbiasedness, Consistency, Efficiency and sufficiency - Maximum likelihood estimation - Method of moments.

UNIT II TESTING OF HYPOTHESIS

Sampling distributions - Small and large samples -Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION

Multiple and partial correlation - Method of least squares - Plane of regression - Properties of residuals - Coefficient of multiple correlation - Coefficient of partial correlation - Multiple correlation with total and partial correlations - Regression and partial correlations in terms of lower order co - efficient.

UNIT IV DESIGN OF EXPERIMENTS

Analysis of variance - One way and two way classifications - Completely randomized design - Randomized block design - Latin square design - 2² Factorial design.

UNIT V MULTIVARIATE ANALYSIS

Random vectors and matrices - Mean vectors and covariance matrices - Multivariate normal density and its properties - Principal components : Population principal components - Principal components from standardized variables.

TOTAL: 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following topics:

- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Concept of linear regression, correlation, and its applications.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES:

- 1. Gupta.S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand and Sons, 2020.
- 2. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.
- 3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.

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- 4. Johnson, R.A. and Wichern, D. W. "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, Asia, 2012.
- 5. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.

COs- PO's & PSO's MAPPING

	PO01	PO02	PO03	PO04	PO05	PO06
CO1	2	1	3	-	-	-
CO2	2	1	3	-	-	-
CO3	2	1	3	-	-	-
CO4	-	-	1	-	-	-
CO5	2	1	3	-	-	-
Avg.	1.6	0.8	2.6	-	-	-



MODERN CONSTRUCTION MATERIALS

OBJECTIVE:

P24CN101

To study and understand the properties of modern construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non-weathering materials, and smart materials.

UNIT I STRUCTURAL MATERIALS

Wood and Wood Product - Metals - Types of Steels - Manufacturing process of steel - Advantages of new alloy steels - Properties and advantages of aluminum and its products - Types of Coatings & Coatings to reinforcement - Applications of Coatings.

UNIT II 9 NON-STRUCTURAL MATERIALS, ASSOCESSORIES AND FINISHES

Introduction of Non-Structural Materials and Criteria for Selection - Types and properties of Water Proofing Materials – Types of Non-weathering Materials and its uses – Types of Polymer Floor Finishes - Paint - Tiles - Acoustic Treatment materials - Dry Walls - Anchors.

UNIT III **COMPOSITES**

Types of Plastics - Polymer - Properties & Manufacturing process - Advantages of Reinforced polymers - Types of FRP - FRP on different structural elements - Applications of FRP - Bituminous Materials - Glass - Closure - Environmental Concerns.

SPECIAL CONCRETES UNIT IV

Concretes - Behavior of concretes - Properties and Advantages of High Strength and High Performance Concrete - Properties and Applications of Fibre Reinforced Concrete, Self-compacting concrete, Geo Polymer Concrete, Alternate Materials to concrete on high performance & high Strength concrete.

UNIT V SMART AND INTELLIGENT MATERIALS

Types & Differences between Smart and Intelligent Materials - Special features - Nano Concrete -Nano Technology in Construction - Case studies showing the applications of smart & Intelligent Materials.

OUTCOMES:

TOTAL: 45 PERIODS

- On completion of the course, the student is expected to be able to
- CO1 Explain the various types of special concretes
- CO2 Select the different processing of steel and applications of coating
- CO3 Explain the manufacturing process and applications of polymer composites
- CO4 Identify the different flooring materials and application of facade materials
- CO5 Apply the knowledge of smart and intelligent materials in construction field

REFERENCES:

- N.Subramanian,"Building Materials Testing and Sustainability", Oxford Higher Education, 1. 2019.
- 2. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2019.
- 3. Ganapathy, C. "Modern Construction Materials", Eswar Press, 2015.
- SanthakumarA.R. "Concrete Technology", Oxford University press, New Delhi, 2006. 4.
- Ashby, M.F. and Jones D.R.H.H. "Engineering Materials 1: An introduction to Properties, 5. applications and designs", Elsevier Publications, 2005.

COs- PO's & PSO's MAPPING

	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	2	3
CO2	3	1	2	2	2	3
CO3	3	1	3	1	1	3
CO4	2	1	2	2	1	1

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CO5 3 1 3 1 1 1



P24CN102 PROJECT FORMULATION AND APPRAISAL LTPC

OBJECTIVE:

• To study and understand the formulation, and costing of construction projects, appraisal, finance, and private sector participation.

UNIT I PROJECT FORMULATION

Project – Concepts – Capital investments - Generation and Screening of Project Ideas - Project identification - Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.

UNIT II PROJECT COSTING

Project Cash Flows - Principles - Types - New Project and Replacement Project - Biases in Cash flow Estimation - Time Value of Money - Present Value - Future Value - Single amount - Annuity - Cost of Capital - Cost of Debt, Preference, Equity - Proportions - Cost of Capital Calculation - Financial Institutions Considerations.

UNIT III PROJECT APPRAISAL

NPV - BCR - IRR - ARR - Urgency - Pay Back Period - Assessment of Various Methods - Indian Practice of Investment Appraisal - International Practice of Appraisal - Analysis of Risk - Different Methods - Selection of a Project and Risk Analysis in Practice.

UNIT IV PROJECT FINANCING

Project Financing - Means of Finance - Financial Institutions - Special Schemes - Key Financial Indicators - Ratios - financial cost-benefit analysis, social-cost benefit analysis.

UNIT V PRIVATE SECTOR PARTICIPATION

Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT-Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.

TOTAL: 60 PERIODS

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OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Perform Formulations Of Projects
- CO2 Analyze Project Costing
- CO3 Evaluate Project Appraisal
- CO4 Apply Project Financing
- CO5 Perform Private Sector Participation & Implementation

REFERENCES:

- 1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, first edition, 1995.
- 2. Joy P.K., Total Project Management The Indian Context, New Delhi, Laxmi Publications Pvt. Ltd, First edition 2017.
- 3. Prasanna Chandra., Projects Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi., Ninth edition, 2019.
- 4. United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1995.
- 5. Raina V.K, "Construction Management Practice The inside Story", Tata McGraw Hill Publishing Limited, 2005

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	1	3
CO3	3	3	3	3	2	2
CO4	3	2	3	3	1	3
CO5	3	1	2	3	2	2

COs- PO's & PSO's MAPPING



P24CN103 CONSTRUCTION EQUIPMENT AND MANAGEMENT L

OBJECTIVE:

• To study and understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

UNIT I CONSTRUCTION EQUIPMENT SELECTION

Identification - Planning of equipment - Selection of Equipment - Equipment Management in Projects - Maintenance Management - Equipment cost - Operating cost - Cost Control of Equipment - Depreciation Analysis - Replacement of Equipment- Replacement Analysis - Safety Management.

UNIT II EQUIPMENT FOR EARTHWORK

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III OTHER CONSTRUCTION EQUIPMENT

Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting - Equipment for Demolition.

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UNIT IV ASPHALT AND CONCRETING EQUIPMENT

Aggregate production- Different Crushers - Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment - Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.

UNIT V MATERIALS HANDLING EQUIPMENT

Forklifts and related equipment - Portable Material Bins - Material Handling Conveyors - Material Handling Cranes- Industrial Trucks.

TOTAL: 45 PERIODS

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OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Develop knowledge on the planning of equipment and selection of equipment
- CO2 Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment
- CO3 Develop the knowledge on special construction equipments
- CO4 Apply the knowledge on asphalt and concrete plants
- CO5 Apply the knowledge and select the proper materials handling equipment

REFERENCES:

- 1. Peurifoy, R.L., Schexnayder, C. and AviadShapira., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2010.
- 2. Granberg G., Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006
- 3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 2001.
- 4. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, DhanpatRai and Sons, 2010.
- 5. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2019

	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	2	2
CO2	3	1	2	3	2	3
CO3	3	1	3	3	2	3
CO4	3	1	3	3	2	3
CO5	3	1	3	3	2	3

COs- PO's & PSO's MAPPING



P24RM101 RESEARCH METHODOLOGY AND IPR

L T P C 2 0 0 2

UNIT I RESEARCH DESIGN

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL :30 PERIODS

REFERENCES

- 1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
- 2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
- 3. David Hunt, <u>Long Nguyen</u>, <u>Matthew Rodgers</u>, "Patent searching: tools & techniques", Wiley, 2007.
- 4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

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P24CN104 ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY

L T P C 0 0 4 2

A) ADVANCED CONSTRUCTION ENGINEERING LABORATORY

OBJECTIVE:

• To provide a thorough knowledge of material selection through the material testing based on specification

LIST OF EXPERIMENTS

- 1. Mix design of concrete as per IS, ACI & BS methods for high-performance concrete.
- 2. Flow Characteristics of Self Compacting concrete.
- 3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength, and durability.
- 4. NDT on hardened concrete UPV, Rebound hammer, and core test.
- 5. Permeability test on hardened concrete (RCPT) Demonstration

TOTAL:30 PERIODS

OUTCOMES:

On completion of the course, the student will be able to

- **CO1** Do the mix proportion using IS and ACI codal provisions.
- CO2 Analyse the flow characteristics of SCC
- **CO3** Analyse the effect of mineral and Chemical Admixtures
- **CO4** Test the concrete in a non-destructive manner using a rebound hammer.
- **CO5** Know the permeability characteristics of concrete.



B) EXPERIMENTAL TECHNIQUES LABORATORY

OBJECTIVE:

- To provide a detailed account of modern experimental techniques in construction Engineering research.
- To introduce the basic working principles, the operational know how, and the strength and limitations of the techniques.

LIST OF EXPERIMENTS

- 1. Determination of elastic constants Hyperbolic fringes
- 2. Determination of elastic constants Elliptical fringes
- 3. Strain gauge meter Determination of Young's modulus of a metallic wire
- 4. Ultrasonic interferometer ultrasonic velocity in liquids
- 5. Electrical conductivity of metals and alloys with temperature-four probe method
- 6. Resistivity measurements
- 7. NDT Ultrasonic flaw detector
- 8. Calibration of Proving Ring and LVDT

TOTAL :30 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to
- **CO1** Apply the experimental methods to correlate with the theory.
- CO2 Learn the usage of electrical systems for various measurements.
- **CO3** Learn the usage of optical systems for various measurements.
- **CO4** Analyse of Data and interpretation
- **CO5** Apply the analytical techniques and graphical analysis to interpret the experimental data

COs- PO's & PSO's MAPPING

	P01	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	1	2
CO2	2	2	3	3	1	2
CO3	2	2	3	3	1	2
CO4	2	2	3	3	2	2
CO5	2	2	3	2	2	2



P24CN105

TECHNICAL SEMINAR

L T P C 0 0 2 1

OBJECTIVE:

 To work on a specific technical topic in Construction Engineering and Management in order to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

SYLLABUS: The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to construction engineering and management and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30 PERIODS

OUTCOME:

- CO1 Identify latest developments in the field of Construction Engineering
- CO2 Identify latest developments in the field of Construction Management
- CO3 Presentation Skills and ability to answer the queries during Interaction
- CO4 Acquire technical writing abilities for seminars, conferences and journal publications
- CO5 Use modern tools to present the technical details

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	3
CO2	2	3	3	3	2	3
CO3	2	3	3	3	2	3
CO4	3	3	3	3	2	3
CO5	3	3	3	3	2	3



P24CN201

ADVANCED CONSTRUCTION TECHNIQUES

OBJECTIVE:

- To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures.
- To gain the knowledge about the rehabilitation and strengthening techniques.
- To learn about the various demolition techniques.

UNIT I SUB STRUCTURE CONSTRUCTION

Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

UNIT II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS

Vacuum dewatering of concrete flooring - Concrete paving technology - Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections - Erection techniques of tall structures, Large span structures - launching techniques for heavy decks - in-situ prestressing in high rise structures, Post tensioning of slab- Aerial transporting - Handling and erecting lightweight components on tall structures.

UNIT III CONSTRUCTION OF SPECIAL STRUCTURES

Erection of lattice towers - Rigging of transmission line structures - Construction sequence in cooling towers, Silos, chimney, and sky scrapers - Bow string bridges, Cable stayed bridges - Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes - Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

UNIT IV REHABILITATION AND STRENGTHENING TECHNIQUES

Seismic retrofitting - Strengthening of beams, columns, slab and masonry wall - Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

UNIT V DEMOLITION

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Classify the modern construction techniques used in the sub structure construction.
- **CO2** Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings
- **CO3** Summarize the concepts used in the construction of special structures
- **CO4** Distinguish Various strengthening and repair methods for different cases.
- **CO5** Identify the suitable demolition technique for demolishing a building.

REFERENCES:

- 1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 2000.
- 2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy, 2020
- 3. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
- 4. Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
- 5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi,

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COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	2	3
CO2	3	1	3	2	2	2
CO3	3	1	3	3	2	3
CO4	3	1	3	3	2	3
CO5	2	1	3	2	2	2



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P24CN202 CONSTRUCTION PLANNING, SCHEDULING, AND CONTROL LTPC

OBJECTIVE:

- To study and understand the concept of planning.
- To impart concepts in Network representation and analysis.
- To impart concepts in Precedence Network analysis.
- To impart concepts in resource scheduling.
- To learn Concepts in project monitoring and controlling

UNIT I CONSTRUCTION PLANNING

Basic Concepts in the Development of Construction Plans - Choice of Technology and Construction Method - Defining Work Tasks and Work Break down Levels - Defining Precedence Relationships among Activities - Estimating Activity Durations - Estimating Resource Requirements for Work Activities - Coding Systems - Planning Project Schedule and Budget.

UNIT II NETWORK REPRESENTATION AND ANALYSIS

Duration Estimation - Gantt / Bar Chart - Types of Network and Techniques - Introduction to Floats, Types of Floats, usage of Floats for Project Decisions - Presenting Project Schedules - Scheduling for Activity-on-Node and with Leads, Lags, and Windows - Critical Path Method (CPM) Network Analysis - PERT Network Modeling and Time Analysis - Case Illustrations.

UNIT III PRECEDENCE NETWORK ANALYSIS

Introduction to Precedence Diagramming Method (PDM) - PDM network representation, Procedure and Analysis, Issues in PDM, Case Illustrations, Defining Relationship, Project Monitoring and Control Process.

UNIT IV SCHEDULING PROJECT WORK AND RESOURCE SCHEDULING

Work Scheduling Fundamentals - Bar chart method of Work scheduling - Network Based Project Scheduling - Line of Balance Scheduling for Repetitive Projects - Scheduling with Uncertain Durations - Resources Scheduling Considerations - Crashing and Time/Cost Trade-offs- Case Illustrations - Use of Project management Software for scheduling Process.

UNIT V PROJECT MONITORING AND CONTROLLING

The Cost Control Approach - Direct and Indirect Cost Control - Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Performance Control using Earned Value Management Concepts - Time progress monitoring and Controlling - Time Reduction Techniques - Guidelines for reviewing project Time and Cost Progress.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Identify and estimate the activity in the construction.
- **CO2** Schedule the networking of activities using the critical path method.
- **CO3** Evaluate the project budget required for the particular construction project.
- **CO4** Recognize the various quality control tool required in the construction industry.
- **CO5** Explain the different databases that can be maintained in the construction industry using computers.

REFERENCES:

- 1. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA, 2017.
- 2. Chitkara K K., Construction project management, planning, scheduling and control, McGraw Hill (INDIA) publishers, New Delhi, third edition 2014.
- 3. Chris Hendrickson and Tung Au, Project Management for Construction Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
- 4. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopaedia of terms and Applications, Wiley, New York, 1995.
- 5. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons,

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New York, 1985.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	3	1	3
CO2	2	1	2	3	3	2
CO3	2	2	2	2	3	2
CO4	3	1	3	3	2	3
CO5	3	1	3	2	2	3


P24CN203

CIVIL CONTRACT AND REGULATIONS

OBJECTIVE:

- To study the various types of construction contract and their legal aspects and provisions..
- To learn concepts in Tenders.
- To learn concepts in Arbitration and legal requirements
- To study the concepts in labour regulations.

UNIT I CONSTRUCTION CONTRACTS

Indian Contracts Act - Elements of Contracts - Types of Contracts - Features - Suitability - Design of Contract Documents - International Contract Document - Standard Contract Document - Law of Torts.

UNIT II TENDERS

Prequalification - Bidding - Accepting - Evaluation of Tender from Technical, Contractual and Commercial Points of View - Contract Formation and Interpretation - Potential Contractual Problems - World Bank Procedures and Guidelines - Tamilnadu Transparency in Tenders Act.

UNIT III ARBITRATION

Comparison of Actions and Laws - Agreements - Subject Matter - Violations - Appointment of Arbitrators - Conditions of Arbitration - Powers and Duties of Arbitrator - Rules of Evidence - Enforcement of Award – Costs.

UNIT IV LEGAL REQUIREMENTS

Insurance and Bonding - Laws Governing Sale, Purchase and Use of Urban and Rural Land - Land Revenue Codes - Tax Laws - Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs - Legal Requirements for Planning - Property Law - Agency Law - Local Government Laws for Approval - Statutory Regulations.

UNIT V LABOUR REGULATIONS

Social Security - Welfare Legislation - Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration - Insurance and Safety Regulations - Workmen's Compensation Act - Indian Factory Act - Tamilnadu Factory Act - Child Labour Act - Other Labour Laws.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Design the construction contracts
- **CO2** Develop a skill for the tendering process.
- **CO3** Explain the duties of the arbitrator.
- **CO4** Develop an idea on the various legal requirements to be met in relation to land and construction.
- **CO5** Identify and apply the provisions provided in the labour welfare schemes.

REFERENCES:

- 1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, 2000.
- 2. Jimmie Hinze, Construction Contracts, McGraw Hill, 3rd Edition, 2013.
- 3. Ali D. Haidar, Handbook of Contract Management in Construction, Springer Cham, 1st Edition, 2021
- Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 4th Edition 2015.
- 5. Dharmendra Rautray, Principles of Law of Arbitration in India, Wolters Kluwer, 2018.

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	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	2	3	3	3	3
CO3	3	1	3	3	2	2
CO4	3	1	3	3	3	2
CO5	3	1	3	3	3	2



Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai) Department: M E, Construction Engineering And Management, R2024, CBCS

P24CN204 CONSTRUCTION MANAGEMENT STUDIO LABORATORY

LT PC 0 0 4 2

OBJECTIVE:

- To train the students in utilizing the sophisticated spreadsheets programs,
- To train the students to handle estimation software.
- To train the students to handle the Project management software.

LIST OF EXPERIMENTS

- 1. Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.
- 2. Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.
- 3. Simulation models for project risk analysis.
- 4. Virtual progress tracking of small construction project using Navisworks
- 5. Model a simple building project using Building Information Modelling (BIM)

TÓTAL:60 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Prepare the proposal for a construction project
- **CO2** Store and retrieve information about the equipments.
- CO3 Track the activities and schedule a construction project using PRIMAVERA
- **CO4** Track and schedule a construction project using MS Project.
- **CO5** Develop a simulation model for analysing the project risk

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	2	3	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	3



STATISTICAL ANALYSIS FOR CONSTRUCTION ENGINEERS LABORATORY

L T P C 0 0 4 2

OBJECTIVE:

P24CN205

- To provide hands on training in basic spread sheet software.
- To provide hands on training in advanced spread sheet software.
- To provide hands on training in data analytical tools.

LIST OF EXPERIMENTS:

- 1. Descriptive Statistics: frequency distribution, Applications (Charts, Graphs etc.)
- 2. Use of statistical packages Correlation, ANOVA, Cross Tabulation, *t*-Test and Simple and Multiple Regression
- 3. Solving Linear Programming Problems, Transportation and Assignment Models
- 4. Solving Network Flow Models
- 5. Solving Decision making Problems in Project Management

TOTAL: 60 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Formulate descriptive statistics with charts and graphs using spreadsheet softwares and interpretation of results
- **CO2** Analyse construction management field data using Statistical tools.
- **CO3** Solve Linear Programming Problems, transportation and assignment problems by appropriate techniques and evaluate the behaviour under different range of parameters
- CO4 Perform network analysis and decision making in project management
- **CO 5** Solve Construction management problems using decision making tool.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	2	3	3	2	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	3



P24CN301

PRACTICAL TRAINING (4 Weeks)

L T P C 0 0 0 2

OBJECTIVE:

• To train the students in the fieldwork so as to have firsthand knowledge of practical problems related to Construction Management in carrying out engineering tasks.

SYLLABUS: The students individually undertake training in reputed engineering companies doing construction during the summer vacation for a specified duration of four weeks. At the end of the training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Describe the Construction Industry
- **CO2** Realize the various functions of construction activities
- **CO3** Develop skills in facing and solving the problems experiencing in the Construction Management field
 - **CO4** Report Preparation
 - CO5 Presentation of work carried out in Practical Training

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	2	2
CO2	2	2	2	3	2	2
CO3	3	2	2	3	2	2
CO4	3	3	3	3	3	3
CO5	2	3	3	3	3	3



P24CN302

PROJECT WORK I

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OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOME:

- On completion of the course, the student will be able to
- **CO1** Apply the knowledge gained from theoretical and practical courses in solving problems.
- **CO2** Summarize the importance of literature review.
- CO3 Identify the problem
- **CO4** solve the identified problem based on the formulated methodology
- **CO5** Interpret and present the findings of the work conducted.

	PO1	PO2	PO3	PSO 1	PSO 2	PSO 3
CO1	3	2	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3



P24CN401

PROJECT WORK II

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OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze the research problem.
- To develop skills to discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology/ Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOME:

- On completion of the course, the student will be able to
- **CO1** Discover the potential research areas.
- **CO2** Apply the knowledge gained from theoretical and practical courses to be creative, well planned, organized and coordinated.
- CO3 Identify the problem.
- **CO4** solve the identified problem based on the formulated methodology
- CO5 Interpret and present the findings of the work conducted

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	3	3
CO2	3	2	2	3	3	3
CO3	2	2	2	3	3	3
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	3



P24CN501

ADVANCED CONCRETE TECHNOLOGY

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OBJECTIVE:

To study the properties of concrete making materials, tests, mix design, special concretes, and various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS

Aggregates classification IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates - Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements - Water -Chemical admixtures. Mineral admixture.

UNIT II **MIX DESIGN**

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method - Mix design for special concretes- changes in Mix design for special materials.

UNIT III **CONCRETING METHODS**

Process of manufacturing of concrete, methods of transportation, placing and curing, cracking, plastic shrinkage, Extreme weather concreting, special concreting methods. Vacuum dewatering -Underwater Concrete

UNIT IV SPECIAL CONCRETES

Light weight concrete Fly ash concrete, Fiber reinforced concrete, Sulphur impregnated concrete, Polymer Concrete - High performance concrete. High performance fiber reinforced concrete, Self-Compacting Concrete, Geo Polymer Concrete, Waste material-based concrete – Ready mixed concrete.

UNIT V **TESTS ON CONCRETE**

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage Durability of concrete. Non-destructive Testing Techniques - microstructure of concrete

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to
 - Develop knowledge on various materials needed for concrete manufacture CO1
 - CO2 Apply the rules to do mix designs for concrete by various methods
 - CO3 Develop the methods of manufacturing of concrete.
 - CO4 Explain about various special concrete
 - CO5 Explain various tests on fresh and hardened concrete

REFERENCES:

- 1. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2017.
- Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2019. 2.
- 3. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
- 3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
- Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015. 4.
- 5. i.s. 516(1959) Methods of Tests for Strength on Concrete.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	2	1	1
CO2	2	2	2	2	2	2
CO3	3	2	3	3	1	2
CO4	3	2	3	2	2	1
CO5	2	2	2	2	2	2

COs- PO's & PSO's MAPPING

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P24CN502 HUMAN RESOURCES MANAGEMENT IN CONSTRUCTION

OBJECTIVE:

• To understand the various aspects of manpower management and to help the student further develop their management, team building and leadership skills so as to increase their effectiveness in their job performance on international projects.

UNIT I MANPOWER PLANNING

Manpower planning and forecasting - Recruitment, selection process-Sources- Induction-Orientation and Training -Manpower Planning process - Organising, Staffing, directing, and controlling – Factors influencing supply and demand of human resources - Role of HR manager -Personnel Principles.

UNIT II ORGANISATION

Elements of an organisation- Management process in organisations- Planning-Organising-Staffing-Directing- Controlling - Delegation of authority - responsibility - accountability - lines and staff organisation Workforce diversity- international dimensions of Organisation- Organisational structure- determinants of organisational design

UNIT III HUMAN RELATIONS AND ORGANISATIONAL BEHAVIOUR

Basic individual psychology - Approaches to job design and job redesign - Self managing work teams - Intergroup - Conflict in organizations - Leadership-Engineer as Manager -aspects of decision making - Significance of human relation and organizational - Individual in organization - Motivation - Personality and creativity - Group dynamics, Team working - Communication and negotiation skills.

UNIT IV WELFARE MEASURES

Establishing Pay plans - Basics of compensation - factors determining pay rate - Current trends in compensation - Job evaluation - Incentives- Practices in Indian organisations - Statutory benefits - non-statutory (voluntary) benefits - Insurance benefits - retirement benefits and other welfare measures to build employee commitment - Laws related to welfare measures.

UNIT V MANAGEMENT AND DEVELOPMENT METHODS

Management Development - On-the-job and off-the-job- Management Developments - Performance appraisal in practice. Managing careers: Career planning and development - Managing promotions and transfers of operations – Developing policies, practices and establishing process pattern – Competency upgradation and their assessment – New methods of training and development – Performance Management. TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Demonstrate practices and techniques for evaluating performance, structuring teams, coaching and mentoring people.
- **CO2** Explain the role of the leader and leadership principles and attitudes
- CO3 Demonstrate an understanding of professional and ethical responsibilities; and
- **CO4** Demonstrate commitment to quality, timeliness, and continuous improvement.
- **CO5** Interpret their future managerial role, with emphasis on the management of the human resources and with a multi-cultural perspective

REFERENCES

- 1. Charles D Pringle, Justin GooderiLongenecter, Management, CE Merril Publishing Co. 2001.
- 2. Dwivedi R.S, Human Relations and Organisational Behaviour, Macmillian India Ltd., 2005.
- 3. Josy .J, Familaro, "Handbook of Human Resources Administration", McGraw-Hill International Edition, 2007
- 4. D. Longford M.R. Hancock, R. Rellows& A. W. Gale, Human Recourse Management In Construction.- Longman Group Limited , fourth impression 2000.
- 5. Carleton Counter II and Jill Justice Coulter, "The Complete Standard Hand Book of

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Construction Personnel Management ", Prentice Hall, Inc., New Jersey, 1989.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	3	3
CO2	2	1	1	3	3	3
CO3	1	1	2	3	3	3
CO4	2	2	1	3	3	3
CO5	2	1	2	3	3	3



P24CN503 CONSTRUCTION PROJECT MANAGEMENT

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OBJECTIVE:

• To study the various management techniques for successful completion of construction projects.

UNIT I FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT

Introduction of construction Project Management - Construction Scope - Construction Project Characteristics - Project development and Life Cycle - Construction Project Management Practice - Roles and Functions and Responsibility of Construction Managers and Major causes of Project failure.

UNIT II PLANNING AND ORGANIZING CONSTRUCTION PROJECT

Construction Project organization – Planning Project work Scope and integration Processes -Defining Project Activities - Scheduling Project - CPM, PERT, Precedence Network Analysis – Planning and organizing project resources such as manpower, material, equipment, Time and cost for construction site.

UNIT III DESIGN AND CONSTRUCTION PROCESS

Design and Construction as an Integrated System – Innovation, Economic and Technological Feasibility - Design Methodology - Functional Design - Construction Site Environment - Case Studies - Project Clearance requirement, Procedure and Necessary Documentation for Major Works Like Dams, Multistoried Structures, Ports, Tunnels.

UNIT IV PROJECT RESOURCES UTILIZATION

Labor productivity variations, productivity improvement - work study - Materials purchase & inventory control - Construction Equipment - Choice of Equipment and Standard Production Rates – Time management and Cost management - Measuring project progress & performance – Tools and Techniques

UNIT V RISK MANAGEMENT AND PROJECT CONTROLLING

Risks management at construction site - Controlling resource productivity - Schedule and Cost Controlling system - Earned value management system - Project Management Information systems.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Explain the stages involved in a project and analyze the obligatory services to be taken up while performing a construction activity.
- **CO2** Apply the scheduling techniques for planning construction project.
- **CO3** Develop the ability to integrate design and construction Process
- **CO4** Analyzing Resources utilization and resource productivity.
- **CO5** Assess the risk and controlling systems using project management Information system.

REFERENCES:

- 1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 3rd Edition, 2014.
- 2. Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 2017.
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- 4. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology,4th Edition, 2013.
- 5. Kumar Neeraj Jha, Construction Project Management Theory and Practices, Pearson, 2012.



	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	1	2	3	2	2
CO3	3	3	2	3	3	2
CO3	2	1	2	2	2	2
CO3	3	1	2	2	1	2



SUSTAINABLE CONSTRUCTION

OBJECTIVE:

P24CN504

• To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

UNIT I INTRODUCTION

Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO₂ contribution from cement and other construction materials.

UNITII MATERIALS USED IN SUSTAINABLE CONSTRUCTION

Construction materials and indoor air quality - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

UNITIII ENERGY CALCULATIONS

Components of embodied energy - calculation of embodied energy for construction materials -Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use

UNITIV GREEN BUILDINGS

Control of energy use in building - ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling - Performance ratings of green buildings - Zero energy building

UNITV ENVIRONMENTAL EFFECTS

Non-renewable sources of energy and Environmental aspects - energy norm, coal, oil, natural gas - Nuclear energy - Global temperature, Green house effects, global warming - Acid rain: Causes, effects and control methods - Regional impacts of temperature change.

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Summarize the various sustainable materials used in construction.
- CO2 Explain the method of estimating the amount of energy required for building.
- CO3 Interpret the features of LEED, TERI and GRIHA ratings of buildings.
- **CO4** Relate the concept and performance of zero energy buildings.
- **CO5** Select less carbon emission materials for construction.

REFERENCES:

- Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
- 2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell, UK, 2016.
- 3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.

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- 4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2012.
- 5. New Building Materials and Construction World magazine

	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	1	2	1
CO2	3	2	3	2	2	2
CO3	3	3	2	1	3	1
CO3	3	3	3	2	3	2
CO3	3	1	2	2	3	2



ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION P24CN505 LTPC 3 0 0 3

OBJECTIVE:

To introduce the various aspects of Construction economics and finance with the systematic • evaluation of cost and benefit associated with different projects.

UNIT I **BASIC PRINCIPLES**

Time Value of Money - Cash Flow diagram - Nominal and effective interest- continuous interest. Single Payment Compound Amount Factor (P/F,F/P) - Uniform series of Payments (F/A,A/F,F/P,A/P)- Problem time zero (PTZ)- equation time zero (ETZ). Constant increment to periodic payments - Arithmetic Gradient(G), Geometric Gradient (C).

UNIT II **COMPARING ALTERNATIVES PROPOSALS**

Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR)Analysis, Benefit/Cost Analysis, Break Even Analysis.

EVALUATING ALTERNATIVE INVESTMENTS UNIT III

Real Estate - Investment Property, Equipment Replace Analysis, Depreciation - Tax before and after depreciation - GST- Input Tax Credit (ITC) - Assessment and Administration of GST -Inflation.

UNIT IV FUNDS MANAGEMENT

Project Finance – Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial managementforeign currency management.

UNIT V FUNDAMENTALS OF MANAGEMENT ACCOUNTING

Management accounting, Financial accounting principles- basic concepts, Financial statements accounting ratios - funds flow statement - cash flow statement.

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TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to •
- CO1 Summarize the basic principles of Economic in construction
- CO2 Evaluate alternate proposals
- CO3 Evaluate alternative investments
- CO4 Select best source of finance for a project
- CO5 Elaborate the finance and accounting

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REFERENCES:

- 1. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000
- 2. Shrivastava, U.K., Construction Planning and Management, 2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi., 2001.
- 3. Blank, L.T., and Tarquin,a.J Engineering Economy,4th Edn. Mc-Graw Hill Book Co., 1988
- 2. Collier C and GlaGola C Engineering Economics & Cost Analysis, 3nd Edn. Addison Wesley Education Publishers., 1998.
- 5. Steiner, H.M. Engineering Economic principles, 2nd Edn. McGraw Hill Book, 1996

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	3	3	1
CO2	2	2	1	2	2	1
CO3	1	2	2	3	3	2
CO4	2	2	1	2	2	1
CO5	1	1	2	1	1	3



P24CN506 DESIGN OF ENERGY EFFICIENT BUILDINGS

OBJECTIVE:

• To understanding the concept of energy consumption in buildings and design a energy efficient building

UNIT I INTRODUCTION

Climate adapted and climate rejecting buildings - Heat Transfer - Measuring Conduction - Thermal Storage - Measurement of Radiation - The Greenhouse Effect - Convection - Measuring latent and sensible heat - Psychrometry Chart - Thermal Comfort - Microclimate, Site Planning and Development - Temperature - Humidity - Wind - Optimum Site Locations - Sun Path Diagrams - Sun Protection - Types of Shading Devices - Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING

General Principles of passive Solar Heating - Key Design Elements - Sunspace - Direct gain -Trombe Walls, Water Walls - Convective Air loops - Concepts - Case Studies - General Principles of Passive Cooling - Ventilation - Principles - Case studies - Courtyards - Roof Ponds - Cool Pools - Predicting ventilation in buildings - Window Ventilation Calculations - Room Organization Strategies for Cross and Stack Ventilation - Radiation - Evaporation and dehumidification - Wind Catchers - Mass Effect - Zoning - Load Control - Air Filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING

Materials, components and details - Insulation - Optical materials - Radiant Barriers - Glazing materials - Glazing Spectral Response - Day lighting - Sources and concepts -Building Design Strategies - Case Studies - Daylight apertures - Light Shelves - Codal requirements - Day lighting design - Electric Lighting - Light Distribution - Electric Lighting control for day lighted buildings - Switching controls - Coefficient of utilization - Electric Task Lighting - Electric Light Zones - Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION

Hourly Solar radiation - Heat insulation - Terminology - Requirements - Heat transmission through building sections - Thermal performance of Building sections - Orientation of buildings - Building characteristics for various climates - Thermal Design of buildings - Influence of Design Parameters – Mechanical controls - Examples. Ventilation - Requirements - Minimum standards for ventilation

Ventilation Design - Energy Conservation in Ventilating systems - Design for Natural Ventilation
Calculation of probable indoor wind speed.

UNIT IV DESIGN FOR CLIMATIC ZONES

Energy efficiency - An Overview of Design Concepts and Architectural Interventions - Embodied Energy - Low Embodied Energy Materials - Passive Downdraft Evaporative Cooling - Design of Energy Efficient Buildings for Various Zones - Cold and cloudy - Cold and sunny - Composite -Hot and dry - Moderate - Warm and humid - Case studies of residences, office buildings and other buildings in each zones - Commonly used software packages in energy efficient building analysis and design - Energy Audit - Certification.

OUTCOME:

On completion of this course, the student is expected to be able to

- CO1 Explain environmental energy supplies on buildings
- CO2 Explain the passive solar heating, cooling system
- CO3 Discuss the various aspects of day-lighting and electrical lighting in a building
- **CO4** Predict and design building ventilation and heat control for indoor comfort
- **CO5** Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

REFERENCES

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2018.

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- 2. Brown, G.Z. and DeKay, M., Sun, Wind and Light Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014.
- 3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995
- 4. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.
- 5. Majumdar, M (Ed), Energy Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	1
CO2	2	3	2	3	2	1
CO3	3	2	2	3	2	2
CO4	2	2	3	3	3	3
CO5	3	2	2	2	3	3



Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

P24CN507

PROJECT SAFETY MANAGEMENT

OBJECTIVES:

 To study and understand the various safety concepts and requirements applied to construction projects.

UNIT I CONSTRUCTION ACCIDENTS

Accidents and their Causes - Human Factors in Construction Safety - Costs of Construction Injuries – Occupational and Safety Hazard Assessment - Legal Implications.

UNIT II SAFETY PROGRAMMES

Problem Areas in Construction Safety - Elements of an Effective Safety Programme - Job-Site Safety Assessment - Safety Meetings - Safety Incentives.

UNIT III CONTRACTUAL OBLIGATIONS

Safety in Construction Contracts - Substance Abuse - Safety Record Keeping - Occupational Safety and Health Administration Manuals, Laws and Act - Indian and International Practices.

UNIT IV DESIGNING FOR SAFETY

Safety Culture - Safe Workers - Safety and First Line Supervisors - Safety and Middle Managers – Top Management Practices, Company Activities and Safety - Safety Personnel - Sub contractual Obligation - Project Coordination and Safety Procedures - Workers Compensation.

UNIT V OWNERS' AND DESIGNERS' OUTLOOK

Owners and Designers - Roles and responsibility in ensuring safety - Preparedness - Role of the designer in ensuring safety - Safety clause in the design document.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Develop knowledge on accidents and their causes.
- **CO2** Develop knowledge about safety programs and job-site safety assessments.
- CO3 Apply the knowledge of contractual obligations.
- **CO4** Explain about designing for safety and safety procedures.
- **CO5** Develop the knowledge of owners' and designers' responsibilities.

REFERENCES:

- 1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
- 2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.
- 3. Sathyanarayanan Rajendran and Mandi Kime, Construction Project Safety-Management Best-Practices Handbook, 2013.
- 4. Safety, Health and Environmental Handbook, CPWD, 2019.
- 5. Bhattacharjee S.K. Safety Management in Construction (Principles and Practice), Khanna Publishers, New Delhi 2011

	P01	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	2	2
CO2	2	1	2	2	2	2
CO3	1	1	1	2	1	2
CO4	1	1	2	2	2	2
CO5	1	1	2	2	2	2

COs- PO's & PSO's MAPPING

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P24CN508 COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING

OBJECTIVE:

• To study and understand the optimization techniques, inventory models and scheduling techniques applied to construction engineering.

UNIT I INTRODUCTION

Overview of IT Applications in Construction - Construction process - Computerization in Construction - Computer-aided Cost Estimation - Developing applications with database software.

UNIT II OPTIMIZATION TECHNIQUES

Linear, Dynamic, and Integer Programming - Branch and Bound Techniques – Application to Production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems – Software applications.

UNIT III INVENTORY MODELS

Deterministic and Probabilistic Inventory Models - Software applications.

UNIT IV SCHEDULING APPLICATION

PERT and CPM - Advanced planning and scheduling concepts - Computer applications - Case study.

UNIT V OTHER PROBLEMS

Sequencing problems - Simulation - Enterprises - Introduction to ERP systems.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course, the student is expected to be able to
- **CO1** Use of software's in construction Industry.
- **CO2** Apply various optimization techniques.
- CO3 Apply Deterministic and Probabilistic Inventory Models.
- **CO4** Analyze the scheduling concepts.
- **CO5** Solve problems using simulation and ERP systems.

REFERENCES:

- 1. Billy E. Gillet., Introduction to Operations Research A Computer Oriented Algorithmic Approach, McGraw Hill, 2008.
- 2. Feigenbaum, L., Construction Scheduling with Primavera Project Planner Prentice Hall Inc., 2002.
- 3. Ming Sun and Rob Howard, "Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, 2004.
- 4. Paulson, B.R., Computer Applications in Construction, McGraw Hill, 1995.
- 5. Tarek Hegazy, Computer-Based Construction Project Management, Pearson New International Edition, 2013.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	2	1	1
CO2	1	1	2	3	2	2
CO3	3	2	2	3	2	2
CO4	2	1	1	3	2	2
CO5	1	1	2	2	1	2

COs- PO's & PSO's MAPPING

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P24CN509 QUANTITATIVE TECHNIQUES IN MANAGEMENT

OBJECTIVE:

To study the various quantitative methods applied to the elements of management, the effect of production management, finance management, decision theory, and managerial economics.

UNIT I OPERATIONS RESEARCH

Introduction to Operations Research - Linear Programming - Graphical and Simplex Methods, Duality and Post-Optimality Analysis - Transportation and Assignment Problems.

UNIT II PRODUCTION MANAGEMENT

Inventory Control - EOQ Model - Quantity Discounts - Safety Stock - Replacement Theory - PERT and CPM - Simulation Models - Quality Control.

UNIT III FINANCIAL MANAGEMENT

Working Capital Management - Compound Interest and Present Value methods - Discounted Cash Flow Techniques – Capital Budgeting.

UNIT IV DECISION THEORY

Decision Theory - Decision Rules - Decision making under conditions of certainty, risk and uncertainty - Decision trees - Utility Theory.

UNIT V MANAGERIAL ECONOMICS

Cost Concepts - Break-even analysis - Pricing Techniques - Game theory - Applications.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Apply the knowledge of science and engineering fundamentals in learning the concept of operations research and its practical applicability for solving challenges in construction.
- **CO2** Identify, formulate, plan and schedule construction engineering projects.
- **CO3** Apply the knowledge of financial management and cost concepts.
- **CO4** Design the required man, material, equipment, cost and time as per needs by proper decision rules.
- **CO5** Analyze the cost by break-even analysis and modern construction management software.

REFERENCES:

- 1. Frank Harrison, E., The Managerial Decision-Making Process, Houghton Mifflin Co., Boston, 1999.
- 2. Hamdy. A.Taha, Operations Research: An Introduction, Prentice Hall, 2010.
- 3. Levin, R.I, Rubin, D.S., and Stinson J., Quantitative Approaches to Management, McGraw Hill College, 1993.
- 4. Tang S.L., Irtishad U.Ahmad, Syed M.Ahmed, Ming Lu, Quantitative Technique for Decision making in Construction, Hongkong University Press, HKU, 2004.
- 5. Vohra, Nd., Quantitative Techniques in Management, Fifth Edition, Tata McGraw-Hill Company Ltd, 2017.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	1
CO2	2	2	2	3	3	3
CO3	2	1	1	3	3	2
CO4	2	1	2	3	3	3
CO5	1	1	2	3	3	3

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Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

P24CN510 RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION LTPC

OBJECTIVE:

- To impart the concepts of resource planning
- To impart the concepts of labor management.
- To impart the concepts of material and equipment.
- To impart the concepts of time management.
- To impart the concepts of resource allocation and resource leveling in construction.

UNIT I RESOURCE PLANNING

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

UNIT II LABOUR MANAGEMENT

Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

UNIT III MATERIALS AND EQUIPMENT

Material: Time of purchase, the quantity of material, sources, Transportation, Delivery, and Distribution Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source, and handling.

UNIT IV TIME MANAGEMENT

Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects - Cash flow and cost control.

UNIT V RESOURCE ALLOCATION AND LEVELLING

Time-cost trade-off, Computer application - Resource levelling, resource list, resource allocation, Resource loading, Cumulative cost - Value Management.

TOTAL: 45 PERIODS

OUTCOME:

• On completion of this course, the student is expected to be able to

CO1 Identify the different types of resources in a construction industry

CO2 Evaluate the labour productivity and the influencing factors

CO3 Calculate the equipment output and the operation condition of construction equipment

CO4 Describe the terms of cash inflow, cash outflow, and balance sheet

CO5 Categorize the time and cost-related information in a construction sector.

REFERENCES:

- 1. Sharma, S C., Construction equipment management, Khanna publishers, Delhi, 2016.
- 2. Kumar Neeraj Jha Construction project management, Pearson publishers, 2015.
- 3. Andrew, D., Szilagg, Hand Book of Engineering Management, 1982.
- 4. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1996.
- 5. Paul Netscher, Construction Project Management: Tips and Insights, Panet Publications, 2017.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	3	2	2
CO2	3	2	2	3	2	2
CO3	2	2	2	3	2	2
CO4	3	2	3	3	2	2
CO5	2	2	2	3	2	2

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P24CN511

SHORING, SCAFFOLDING AND FORMWORK

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OBJECTIVE:

- To disseminate knowledge about detailed planning.
- To impart knowledge about materials used in formwork.
- To learn design of formwork and shores.
- To disseminate knowledge about erection of form work.
- To impart knowledge about design of formwork for domes, shells, and tunnels.

UNIT I PLANNING, SITE EQUIPMENT & PLANT FOR FORM WORK

Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

UNIT II MATERIALS ACCESSORIES PROPRIETARY PRODUCTS & PRESSURES 9

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood -Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

UNIT III DESIGN OF FORMS AND SHORES

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability -Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props -Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

UNIT IV BUILDING AND ERECTING THE FORM WORK

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

UNIT V FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS

Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details -Forms for Thin Shell roof slabs design considerations - Building the forms - Placing concrete - Form removed -Strength requirements -Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts. Slip Forms - Principles -Types - advantages - Functions of various components - Planning -Desirable characteristics of concrete - Common problems faced - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

TOTAL: 45 PERIODS

OUTCOME:

On completion of this course, the student is expected to be able to

- **CO1** Explain detailed planning of formwork, plant, and site equipment.
- **CO2** Select material accessories for formwork connection and analyze pressures on formworks.
- **CO3** Design the forms and shores.
- **CO4** Apply the knowledge of erecting forms for beams, slabs, columns, walls, and causes of failures.



CO5 Apply the knowledge of forms and their erection for domes and tunnels, types of slip forms, and scaffolds.

REFERENCES:

- 1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.
- 2. Hurd, M.K., Formwork for Concrete, Seventh Edition, American Concrete Institute, Detroit, 2016
- 3. Michael P. Hurst, Construction Press, London and New York, 2003.
- 4. Robert L. Peurifoy and Garold D. Oberlender, Formwork for Concrete Structures, McGraw Hill, 2010.
- 5. Kumar Neeraj Jha, Formwork for Concrete Structures, 2017

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	2	3	2
CO2	2	2	2	3	2	3
CO3	1	1	1	3	3	3
CO4	3	1	3	3	2	3
CO5	1	1	1	3	2	3



P24CN512 SYSTEM INTEGRATION IN CONSTRUCTION

OBJECTIVE:

- To understand how the various systems that constitute a building design which are interwoven and integrated with a view to achieving a high-performance building;
- To understand about the various environmental factors.
- To understand about the various services.
- To understand about the various maintenance.
- To understand various concepts in safety planning.

UNIT I STRUCTURAL INTEGRATION

Structural System, Systems for enclosing Buildings, Functional aesthetic system, Materials Selection and Specification.

UNIT II ENVIRONMENTAL FACTORS

Qualities of enclosure necessary to maintain a specified level of interior environmental quality weather resistance - Thermal infiltration - Acoustic Control - Transmission reduction - Air quality illumination - Relevant systems integration with structural systems.

UNIT III SERVICES

Plumbing - Electricity - Vertical circulation and their interaction - Heating Ventilation and Airconditioning Systems in Buildings and implementation techniques in High Rise Buildings.

UNIT IV MAINTENANCE

Component longevity in terms of operation performance and resistance to deleterious forces -Planning systems for least maintenance materials and construction – access for maintenance – Feasibility for replacement of damaged components – equal life elemental design – maintenance free exposed and finished surfaces.

UNIT V SAFETY PLANNING

Ability of systems to protect fire - Preventive systems - fire escape system design - Planning for pollution free construction environmental - Hazard free Construction execution for High Rise Buildings.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Integrate the various construction techniques and incorporate into the building process
- **CO2** Appreciate the requirements and elements of HVAC, mechanical, electrical, hydraulic and transportation services in buildings
- **CO3** Design and integrate services into high-rise buildings
- **CO4** Interpret the intricacies of physical installation of services and their critical sequence in the construction process.
- **CO5** Adopt an approach relating systems to aim for a high performance building in various categories of major use

REFERENCES

- 1. A.J. Elder and Martiz Vinden Barg, Handbook of Building Enclosure, McGraw-Hill Book Company, 1983.
- 2. David V. Chadderton, Building Services Engineering, Taylor and Francis, 2013.
- 3. Jane Taylor and Gordon Cooke, The Fire Precautions Act in Practices, 1987.
- 4. Peter R. Smith and Warren G. Julian, Building Services, Applied Science Publishers Ltd., London, 1993.
- 5. William T. Mayer, Energy Economics and Building Design, McGraw-Hill Book Company, 1983.

COs- PO's & PSO's MAPPING

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	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	2	2	3	2	3	2
CO3	2	3	1	2	3	2
CO4	3	1	1	2	3	2
CO5	3	2	3	2	3	2



Meenakshi Sundararajan Engineering College

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P24CN513

ADVANCED DATA ANALYSIS

OBJECTIVE:

- To learn concepts of data for construction management.
- To learn concepts of various data analysis.
- To learn concepts of regression and factor analysis.
- To learn concepts of discriminant and cluster analysis.
- To learn concepts of advanced multivariate data analysis techniques

UNIT I STATISTICAL DATA ANALYSIS

Data and Statistics- Review of Basic Statistical Measures-Probability Distributions-Testing of Hypotheses-Non-Parametric Tests.

UNIT II BASIC CONCEPTS

Introduction - Basic concepts - Uni-variate, Bi-variate and Multi-variate techniques - Types of multivariate techniques - Classification of multivariate techniques - Guidelines for multivariate analysis and interpretation - Approaches to multivariate model building.

UNIT III REGRESSION AND FACTOR ANALYSIS

Simple and Multiple Linear Regression Analysis - Introduction - Basic concepts - Multiple linear regression model - Least square estimation - Inferences from the estimated regression function - Validation of the model. Factor Analysis: Definition - Objectives - Approaches to factor analysis - methods of estimation - Factor rotation - Factor scores - Sum of variance explained - interpretation

of results. Canonical Correlation Analysis - Objectives - Canonical variates and canonical correlation - Interpretation of variates and correlations.

UNIT IV DISCRIMINANT AND CLUSTER ANALYSIS

Discriminant Analysis - Basic concepts - Separation and classification of two populations -Evaluating classification functions - Validation of the model. Cluster Analysis - Definitions -Objectives - Similarity of measures - Hierarchical and Non - Hierarchical clustering methods -Interpretation and validation of the model.

UNIT V ADVANCED TECHNIQUES

Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of Preferences - Output of Conjoint measurements - Utility - Interpretation. Multi-Dimensional Scaling - Definitions - Objectives - Basic concepts - Scaling techniques - Attribute and Non-Attributes based MDS Techniques - Interpretation and Validation of models. Advanced Techniques - Structural Equation modeling

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Describe the different statistical analysis techniques.
- CO2 Students will be able to formulate hypothesis
- **CO3** Explore the basic concepts of statistical analysis
- **CO4** Develop regression and factor analysis model and its interpretation
- **CO5** Create discriminant and cluster analysis model and its interpretation

REFERENCES:

- 1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham& William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2015.
- 2. Barbara G. Tabachnick, Linda S. Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.
- 3. Richard A Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2012.
- 4. David R Anderson, Dennis J Sweeney and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002.
- 5. Howard E.A. Tinsley & Steven D. Brown, Handbook of Applied Multivariate Statistics &

TOTAL: 45 PERIODS

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Mathematical modeling, Academic Press, 2000.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	2	3	1
CO2	2	3	2	2	3	3
CO3	2	1	2	2	2	2
CO4	3	2	2	2	2	3
CO5	1	2	3	2	3	3



P24CN514 ENVIRONMENTAL IMPACT ASSESSMENT FOR CONSTRUCTION L T P C ENGINEERS 3 0 0 3

OBJECTIVE:

- To impart the knowledge and skills required for understanding the various impacts of infrastructure projects on the environment.
- To impart knowledge about prediction and assessment of EIA.
- To impart the knowledge of health and socio-economic impact assessment.
- To impart the knowledge and expose the students to the various methodologies available to assess.
- To impart the knowledge to develop the skill to prepare Environmental Impact Assessment report

UNIT I INTRODUCTION

Sustainable Development challenges and needs - Key approaches for Impact Assessment - EIA approach: historical development - Legal and Regulatory aspects in India - Types and Objectives, Components, Process of EIA.

UNIT II PREDICTION AND ASSESSMENT

Prediction and Assessment: tools - impact on air, water, soil & Noise - Role of Biodiversity impact Assessment - Identification, Prediction and Evaluation of Impacts on Biodiversity - Techniques of Biodiversity impact assessment - EIA Report Preparation - Environmental Management Plan: Preparation and implementation - Mitigation and Rehabilitation plans - Post Project Audit.

UNIT III HEALTH AND SOCIO-ECONOMIC IMPACT ASSESSMENT

Health Assessment: Impact of Environment on Health - Developing framework for Health impact analysis, tools, and techniques - Socio-Economic Impact Assessment: Overview and Scope of Social Impact Assessment - SIA model and the planning process - Land acquisition: Legal aspects, Resettlement & Rehabilitation, and Development.

UNIT IV INTEGRATED ANALYSIS

Integrated Analysis of Environmental, Social, and Health Impacts - Challenges for Integrated Approach - Scope for Integrated approach in economic analysis - CBA, Social CBA, and Cost-effectiveness Analysis - Analytic Hierarchy process-based Approach - Emerging Dimensions and Future Directions.

UNIT V IMPACT OF INFRASTRUCTURE AND ENVIRONMENTAL SERVICES

Case Studies: EIA for Mining, extraction of natural resources and power generation - Primary Processing and Material Production - Material Processing, Manufacturing/Fabrication - Service Sectors - Physical Infrastructure including Environmental Services - Building and Construction Projects - Area Development Projects and Townships - Strategic Environmental Assessment, Technological Assessment, and Risk Assessment.

OUTCOME:

- On completion of the course, the student is expected to be able to
- **CO1** Apply the knowledge of science and engineering fundamentals to sustainable development challenges.
- **CO2** explain the identification, prediction, and evaluation of impacts that will be caused by projects or industries on biodiversity.
- **CO3** Identify the legal requirements of environmental impact assessment for projects.
- **CO4** develop the ability to perform integrated analysis by considering environmental, social, and health impacts.
- **CO5** select appropriate methods for environmental impact assessment for Infrastructure and environmental service.

REFERENCES

- 1. Anjaneyulu, Yerramilli, and Valli Manickam, "Environmental impact assessment methodologies", Hyderabad: BS Publications, Third Edition 2022.
- 2. Lawrence, D.P., "Environmental Impact Assessment Practical Solutions to recurrent

TOTAL: 45 PERIODS

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problems", Wiley-Interscience, New Jersey, 2003.

- 3. Petts, J., "Handbook of Environmental Impact Assessment', Vol., I and II, Blackwell Science, London, 1999.
- 4. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York, 1996.
- 5. World Bank Source Book on Environmental Impact Assessment, 2010

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	3
CO2	2	2	3	3	3	2
CO3	2	1	1	3	2	3
CO4	1	1	3	3	2	2
CO5	3	2	2	3	3	3



P24CN515 LEAN CONSTRUCTION CONCEPTS, TOOLS, AND PRACTICES

LT PC 3003

OBJECTIVE:

- To impart knowledge about the basics of lean construction.
- To impart knowledge about the lean principles.
- To impart knowledge about the core concepts of lean construction.
- To impart knowledge about the lean tools and techniques.
- To impart knowledge about the basics of lean implementation in the construction industry.

UNIT I INTRODUCTION

Introduction and overview of the construction project management -Review of Project Management& Productivity Measurement Systems – Productivity in Construction- Daily Progress Report-The state of the industry for its management practices -construction project phases - Essential features of contemporary construction management techniques - The problems with current construction management techniques- Current production planning.

UNIT II LEAN MANAGEMENT

Introduction to lean management – Toyota's management principle-Evolution of lean in the construction industry - Production theories in construction -Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in the construction industry – Waste Elimination.

UNIT III CORE CONCEPTS IN LEAN

Concepts in lean thinking - Principles of lean construction - Variability and its impact - Traditional construction and lean construction - Traditional project delivery - Lean construction and workflow reliability - Work structuring - Production control.

UNIT IV LEAN CONSTRUCTION TOOLS AND TECHNIQUES

Value Stream Mapping - Work sampling - Last planner system - Flow and pull-based production - Last Planner System - Look ahead schedule - constraint analysis - weekly planning meeting- Daily Huddles - Root cause analysis - Continuous improvement - Just in time.

UNIT V LEAN CONSTRUCTION IMPLEMENTATION

Lean construction implementation- Enabling lean through information technology - Lean in design -Design Structure Matrix Location Based Management System-BIM (Building Information Modelling) - IPD (Integrated Project Delivery) - Sustainability through lean construction approach

TOTAL: 45 PERIODS

OUTCOME:

On completion of this course, the student is expected to be able to

- **CO1** Explains the contemporary management techniques and the issues in the present scenario.
- **CO2** Apply the basics of lean management principles and their evolution from the manufacturing industry to the construction industry.
- **CO3** Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.

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CO4 Apply lean techniques to achieve sustainability in construction projects.

CO5 Apply lean construction techniques in design and modeling

REFERENCES:

- 1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
- 2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
- 3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
- 4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
- 5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site Implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.
- 6. Lincoln H. Forbes , Syed M. Ahmed, Lean Project Delivery and Integrated Practices in Modern Construction, Routledge Publishers, 2nd Edition, 2020.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	3	2	2
CO2	2	1	1	3	3	2
CO3	2	1	1	3	1	2
CO4	3	1	1	3	2	1
CO5	2	1	1	3	2	1



P24CN516 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES LTPC

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OBJECTIVE:

• To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures- Service life behaviour - importance of Maintenance, causes and effects of deterioration. Non-destructive Testing Techniques

UNIT II STRENGTH AND DURABILITY OF CONCRETE

Quality assurance for concrete based on Strength, Durability and Microstructure of concrete - NDT techniques- Cracks- different types, causes – Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES

Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes- Polymer Concrete and Grouting materials- Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets

UNIT IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING 9 Concrete protection methods - reinforcement protection methods- cathodic protection - Sacrificial anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring.

UNIT V REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks. Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition -Case studies

TOTAL: 45 PERIODS

REFERENCES:

- 1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012
- 2. DovKominetzky.M.S., Design and Construction Failures, Galgotia Publications Pvt.Ltd., 2001
- 3. Ravishankar.K.,Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
- 4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
- 5. Hand Book on "Repair and Rehabilitation of RCC Buildings" Director General works CPWD ,Govt of India , New Delhi 2002
- 6. BS EN 1504 Products and systems for the protection and repair of concrete structures Definitions, requirements, quality control and evaluation of conformity

OUTCOMES:

• On completion of the course, the student is expected to be able to

CO1	Explain the importance of maintenance assessment and repair strategies
CO2	Acquire knowledge of strength and durability properties and their effects due
	to climate and temperature.
CO3	Gain knowledge of recent developments in repair
CO4	Explain the techniques for repair and protection methods
CO5	Explain the repair, rehabilitation and retrofitting of structures and demolition
	methods.

COs- PO's & PSO's MAPPING

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СО	PO								
	1	2	3	4	5	6			
1	3	-	2	3	2	2			
2	3	1	-	2	2	1			
3	3	-	2	2	3	1			
4	3	1	-	3	2	2			
5	3	2	1	2	2	1			
Avg	3	1.33	1.67	2.40	2.20	1.40			



P24CN517 QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION

LTPC 3003

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OBJECTIVE:

- To study the concepts of quality management in construction.
- To study the concepts of quality systems.
- To study the concepts of quality planning.
- To study the concepts of quality assurance and control techniques in construction.
- To study the concepts of quality improvement techniques.

UNIT I QUALITY MANAGEMENT

Introduction - Definitions and objectives - Dimensions of quality - Factors influencing construction quality - Responsibilities and authority - Methods to improve quality - Quality Process - Quality plan – Quality Management Guidelines - Quality circles.

UNIT II QUALITY SYSTEMS

Introduction - History of standards - Quality system standard - ISO 9000 family of standards - Requirements - Preparing Quality System Documents - Quality related training - Implementing a Quality system - Third-party Certification - Emission Norms - BS Norms.

UNIT III QUALITY PLANNING

Quality Policy, Objectives and methods in the Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance - TQM - Traditional approach vs. Modern approach - Principles of TQM - Taguchi's concept of quality - Quality function deployment - Codes and Standards - Documents - Contract and construction programming - Inspection procedures - Processes and products - Total QA / QC programme and cost implication.

UNIT IV QUALITY ASSURANCE AND CONTROL

Objectives - Regularity agent, owner, design, contract, and construction-oriented objectives, methods - Techniques and needs of QA/QC - Different aspects of quality - Appraisals - Sampling techniques - Sampling plan - Sampling Terms - AQL, LTPD, AOL - Factors influencing construction quality - Critical, major failure aspects and failure mode analysis, - Stability methods and tools, optimum design - Reliability testing, reliability coefficient and reliability prediction - Failure rate - Mean time to failure - Mean time to repair - Mean time between failures.

UNIT V QUALITY IMPROVEMENT TECHNIQUES

Selection of new materials - Influence of drawings, detailing, specification, standardization - Bid preparation - Construction activity, environmental safety, social and environmental factors - Natural causes and speed of construction - Life cycle costing - Value engineering and value analysis. TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Achieve the knowledge of quality management guidelines, and quality circles.
- **CO2** Apply the quality standards for preparing Quality system documents.
- **CO3** Explain the skill of preparing inspection procedures for quality planning.
- CO4 Select the techniques and tools for Quality Assurance and Control in Construction Industry.
- CO5 Achieve the knowledge of quality improvement techniques

REFERENCES:

- 1. Hutchins. G, ISO 9000: A Comprehensive Guide to Registration, Audit Guidelines and Successful Certification, Viva Books Pvt. Ltd., 1994.
- 2. James, J.O' Brian, Construction Inspection Handbook Total Quality Management, Van Nostrand, 1997
- 3. KB Rajoria, Deepak Naryan, Deepak Gupta, ISO 9000 Practices in construction, CBS Publishers & Distributors Pvt. Ltd.,ISBN:978-93-90709-33-5, 2021.
- 4. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, McGraw Hill, 2001
- 5. Steven McCabe, Quality Improvement Techniques in Construction, Addison Wesley Longman Ltd, 1998.



	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	3	2	2
CO2	2	2	1	2	1	1
CO3	1	2	1	1	3	2
CO4	2	2	3	3	2	2
CO5	1	2	1	1	2	2


P24CN518

DIGITAL DESIGN AND CONSTRUCTION

OBJECTIVE:

- To learn basic concepts of BIM for construction.
- To learn and acquire knowledge in the BIM-based construction design process. •
- To understand the challenges in BIM implementation •
- To learn and acquire knowledge in BIM-based construction automation technologies.
- To learn and acquire knowledge in Modern Digital Technologies in Construction

UNIT I INTRODUCTION TO BIM FOR CONSTRUCTION

Fundamentals of BIM – terminology, CAD & BIM. IFCs, schemas, interoperability, parametric modeling.

UNIT II **DEVELOPMENT OF DESIGN PROCESS**

BIM-based design process and analysis - design coordination. BIM-based construction process -4D. 5D. nD BIM.

UNIT III CHALLENGES IN BIM IMPLEMENTATION

BIM-based operation issues - facility management. Drivers and barriers in BIM adoption, BIM global practices.

CONSTRUCTION AUTOMATION UNIT IV

Automation in design and construction, virtual experiments - augmented reality, virtual reality, use of sensors in construction.

UNIT V MODERN DIGITAL TECHNOLOGIES IN CONSTRUCTION

Robots in construction, autonomous robots, and 3D printing technology in construction. Drones for Construction monitoring, Internet of Things, Smart Manufacturing, etc.

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 To create a BIM model
- **CO2** To develop the construction design process using BIM
- **CO3** To identify the challenges in BIM implementation
- CO4 To use automation techniques in construction
- **CO5** To implement modern digital technologies in construction

REFERENCES:

- 1. Daniotti, Bruno, Gianinetto, Marco, Della Torre, Stefano (Eds.), Digital Transformation of the Design, Construction and Management Processes of the Built Environment, Research for Development, Springer Open, 2020.
- 2. Dominik Holzer, The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction, Wiley, 2016.
- 3. Erica Epstein, Implementing Successful Building Information Modeling, Artech House, 2012.
- 4. Javad Majrouhi Sardroud, Automation in Construction Management, Scholars' Press, 2014.
- 5. Thomas R. Kurfess, Robotics and Automation Handbook, CRC Press, 2018.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	3
CO2	3	3	2	3	3	2
CO3	1	1	1	3	2	3
CO4	3	3	3	3	2	2
CO5	1	1	1	3	3	3

LTPC 3003

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TOTAL: 45 PERIODS

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P24CN519 ORGANIZATIONAL BEHAVIOUR

L T P C 3 0 0 3

OBJECTIVE:

- To learn basic concepts of organizational behavior.
- To gain a solid understanding of human behavior in the workplace from an individual.
- To gain a solid understanding of human behavior in the workplace in the group.
- To learn the concepts of Leadership and power.
- To learn the dynamics of organizational behavior.

UNIT I INTRODUCTION TO ORGANIZATIONAL BEHAVIOUR

Definition, need, and importance of organizational behaviour -Nature and scope -Frame work – Organizational behaviour models.

UNIT II INDIVIDUAL BEHAVIOUR

Personality: types -Factors influencing personality, theories-Types of learners -The learning process -Learning theories -Organizational behaviour modification -Misbehaviour: Types and Management Intervention - Emotions: Emotional Labour -Emotional Intelligence -Theories – Attitudes: Characteristics, Components, Formation, Measurement, and Values - Perceptions: Importance, Factors influencing perception -Interpersonal perception -Impression Management Motivation -importance -Types -Effects on work behavior.

UNIT III GROUP BEHAVIOUR

Organization structure -Formation -Groups in organizations -Influence -Group dynamics – Emergence of informal leaders and working norms -Group decision-making techniques -Team building -Interpersonal relations -Communication -Control.

UNIT IV LEADERSHIP AND POWER

Meaning -Importance-Leadership styles -Theories -Leaders Vs Managers -Sources of power -Power centers -Power and Politics.

UNIT V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR

Organizational culture and climate -Factors affecting organizational climate -Importance of Job satisfaction -Determinants-Measurements - Influence on behavior - Organizational change - Importance -Stability Vs Change - Proactive Vs Reaction change- The change process - Resistance to change - Managing change - Stress - Work Stressors-Prevention and Management of stress - Balancing work and Life - Organizational development -Characteristics and objectives - .Organizational effectiveness.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
- CO1 Identify the need and importance of organizational behavior and the framework of organizational models
- CO2 Explain the various learning theories and develop alternative organizational behavior approaches in the workplace
- **CO3** Describe the importance of group dynamics and team building.
- **CO4** Explore the various leadership styles and politics.
- **CO5** Explain the dynamics of organizational behaviour with the balance of work life.

REFERENCES:

- 1. Stephen P. Robins, "Organisational Behavior", PHI Learning / Pearson Education, 15th edition, 2012.
- 2. FredLuthans, "Organisational Behavior", McGraw Hill, 12th Edition, 2005.
- 3. Schermerhorn, Hunt, and Osborn, "Organisational Behavior", John Wiley, 12th Edition, 2011.
- 4. UdaiPareek, "Understanding Organisational Behaviour", 2nd Edition, Oxford Higher Education, 2008.
- 5. Mc Shane & Von Glinov, "Organisational Behaviour", 6th Edition, Tata McGraw Hill, 2012.

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COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	2	1	2
CO2	2	1	1	2	3	2
CO3	1	2	2	2	2	3
CO4	1	1	1	2	3	1
CO5	1	1	1	3	2	1



P24CN520 SUPPLY CHAIN MANAGEMENT AND LOGISTICS IN CONSTRUCTION L T P C 3 0 0 3

OBJECTIVE:

- To gain knowledge about construction supply chain management.
- To understand the concepts of strategic perspectives.
- To understand the concepts of integrated data management.
- To understand the concepts of construction logistics and sustainability.
- To understand the concepts of logistics operations.

UNIT I INTRODUCTION

Definition of Logistics and SCM: Evolution, Scope, Importance - Supply chain stages and decision phases process view of a supply chain - Supply chain flows- Examples of supply chains- Competitive and supply chain strategies- Achieving strategic fit- Expanding strategic scope- Drivers of supply chain performance- Framework for structuring drivers -Obstacles to achieving fit.

UNIT II STRATEGIC PERSPECTIVES

Challenge of construction logistics-Aggregating global products for just-in-time delivery to construction sites - Construction Logistics - Supply of bulk materials - Effective management of a construction project supply chain - Construction supply chain management strategy.

UNIT III INTEGRATED DATA MANAGEMENT

Impact of BIM and new data management capabilities on supply chain management in construction – Data management for integrated supply chains in construction

UNIT IV CONSTRUCTION LOGISTICS AND SUSTAINABILITY

Role of logistics in achieving sustainable construction – Resource efficiency benefits of effective logistics

UNIT V LOGISTICS OPERATIONS

Role of the construction logistics manager - Third-party logistics operators in construction -Managing construction logistics for confined sites in urban areas - Consolidation centers in construction logistics - Delivery management systems.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course, the student is expected to be able to
- CO1 Describe the conceptual and theoretical backgrounds of Supply Chain Management and logistics
- **CO2** Apply the strategy in logistics functions ranging from planning to execution and control.
- **CO3** Identify the Impact of BIM and new data management capabilities on supply chain management in construction.
- **CO4** Analyze the implications of various strategic choices and decide on a better course of action.
- **CO5** Understand the role of construction logistic Managers and Delivery management systems.

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REFERENCES:

- 1. GregerLundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.
- 2. Supply Chain Management, Strategy, Planning, and Operation Sunil Chopra, Peter Meindl, and Kalra, Pearson Education, 2011
- 3. A. Ravi Ravindran, Donald P. Warsing, Supply Chain Engineering: Models and Applications, CRC Press, 2012.
- 4. G Srinivasan, Quantitative Models in Operations and Supply Chain Management, PHI Learning (P) Ltd, New Delhi, 2010
- 5. David J.Bloomberg, Stephen Lemay and Joe B.Hanna, Logistics, PHI 2010

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	3	1	3
CO2	3	3	3	3	2	1
CO3	1	1	1	3	3	2
CO4	3	1	3	3	2	2
CO5	3	3	3	3	2	3

COs- PO's & PSO's MAPPING



Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

AUDIT COURSES

P24AC01

ENGLISH FOR RESEARCH PAPER WRITING

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OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 -Understand that how to improve your writing skills and level of readability

- CO2 Learn about what to write in each section
- CO3 Understand the skills needed when writing a Title
- CO4 Understand the skills needed when writing the Conclusion
- CO5 Ensure the good quality of paper at very first-time submission

REFERENCES

- 1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
- 2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
- 3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
- 4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.



P24AC02

DISASTER MANAGEMENT

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OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

- CO1: Ability to summarize basics of disaster
- **CO2**: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- **CO3**: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- **CO4**: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- **CO5**: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

- 1. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
- 2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "NewRoyal book Company,2007.
- 3. Sahni, PardeepEt.Al.," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.



P24AC03

CONSTITUTION OF INDIA

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OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

- The Constitution of India, 1950(Bare Act), Government Publication.
- Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.



Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

	С
P24AC04 நற்றமிழ் இலக்கியம் 2 0 0	0
UNIT I சங்க இலக்கியம்	6
1. தமிழின் துவக்க நூல் தொல்காப்பியம் - எழுத்து, சொல், பொருள்	
2. அகநானூறு (82) -இயற்கை இன்னிசை அரங்கம்	
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி	
4. புறநானூறு (95,195) போரை நிறுத்திய ஒளவையார்	
UNIT II அறநெறித் தமிழ்	6
1. அறநெறி வகுத்த திருவள்ளுவர் அறம் வலியுறுத்தல், அன்புடைமை,	
ஒப்புரவறிதல், ஈகை, புகழ்	
2. பிற அறநூல்கள் இலக்கிய மருந்து ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம்,	
ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)	
UNIT III _ இரட்டைக் காப்பியங்கள்	6
1. கண்ணகியின் புரட்சி சிலப்பதிகார வழக்குரை காதை சமூகசேவை	
இலக்கியம் மணிமேகலை சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை	
UNIT IV அருள்நெறித் தமிழ்	6
1. சிறுபாணாற்றுப்படை -பாரி முல்லைக்குத் தேர் கொடுத்தது. பேகன்	
மயிலுக்குப் போர்வை கொடுத்தது. அதியமான் ஔவைக்கு நெல்லிக்கனி	
கொடுத்தது. அரசர் பண்புகள்	
2. நற்றிணை - அன்னைக்குரிய புன்னை சிறப்பு	
3. திருமந்திரம் (617678) - இயமம் நியமம் விதிகள	
4. தரமசசாலையை நிறுவிய வள்ளலார	
5. புறநானுறு - 'சிறுவனே வள்ளலானான	
6. அகநானூறு (4) - வண்டு	
நற்றிணை (11) – நண்டு	
கல்ததொகை (11) - யானை, புறா	
ஐந்தில்லை 50 (27) - யால் அடைய வையன்கிய சென்	
ஆகியலில் பற்றிய செய்திகள் பலாக பட்டைக்கின் கலக்கியல்	(
UNIT v நவன் தமிழ் இலக்கியம் 1 உரைகளுக் கமில்	6
ப் உலர்நலட்த் தயிழ். சமிமின் மால் புதினம்	
தமிழின் முதல் புதிலிய, சமிமின் முதல் திறைகளை	
தமியில் முதல் சிறுகலத், சட்டுரை வெக்கியம் பயண வெக்கியம்	
നലക്ന	
ு நாட்கு விடுகவை போராட்டமும் தமிம் வைக்கியமும்	
2. தாட்டு வருதல்ல் போராட்டமோ தயிழ் இல்லையிடுயி, 3. சமுகாய விடுகலையும் கமிம் வைக்கியமும்	
4 பெண் விடுதலையும் விளிய்பு நிலையினரின் மேம்பாட்டில் கமிம்	
இலக்கியமும்.	
துணைப்படும் 5. அறிவியல் கமிம்.	
6. இணையக்கில் தமிழ்,	
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.	
TOTAL: 30 PEF	IODS
தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்	
1 தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)- www.tamilv	ı.org

- தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) -https://tawikipedia.org தர்மபுர ஆதீன வெளியீடு 2
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- 4 வாழ்வியல் களஞ்சியம் தமிழ்ப் பல்கலைக்கழகம் தஞ்சாவூர்
- 5 தமிழ்கலைக் களஞ்சியம் தமிழ் வளர்ச்சித் துறை
- (thamilvalarchithura.com)
- 6 அறிவியல் களஞ்சியம் தமிழ்ப்பல்கலைக்கழகம், தஞ்சாவூர்



OPEN ELECTIVES

P24OC521

BLOCKCHAIN TECHNOLOGIES

LTPC 3 0 0 3

COURSE OBJECTIVES:

- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like • application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart • contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN

Introduction to Blockchain. Blockchain Technology Mechanisms & Networks. Blockchain Origins. Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II **BITCOIN AND CRYPTOCURRENCY**

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

INTRODUCTION TO ETHEREUM UNIT III

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts,, Transactions, Receiving Ethers, Smart Contracts.

UNIT IV 10 INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

BLOCKCHAIN APPLICATIONS UNIT V

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

COURSE OUTCOMES:

After the completion of this course, student will be able to

CO1: Understand and explore the working of Blockchain technology

CO2: Analyze the working of Smart Contracts

CO3: Understand and analyze the working of Hyperledger

CO4: Apply the learning of solidity to build de-centralized apps on Ethereum

CO5: Develop applications on Blockchain

REFERENCES:

- 1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
- 2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016
- 3. Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014.
- 4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
- 5. D. Drescher, Blockchain Basics. Apress, 2017.

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TOTAL: 45 PERIODS



P24OC522

DEEP LEARNING

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COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics-based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data

- **CO2:** Implement Image Segmentation and Instance Segmentation in Images
- **CO3**: Implement image recognition and image classification using a pretrained network (Transfer Learning)
- **CO4:** Traffic Information analysis using Twitter Data

CO5: Autoencoder for Classification & Feature Extraction

REFERENCES

- 1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
- 2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 2018
- 3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
- 4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017
- 5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress, 2017

TOTAL: 45 PERIODS

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P24OM523 VIBRATION AND NOISE CONTROL STRATEGIES

OBJECTIVES

- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT I BASICS OF VIBRATION

Introduction – Sources and causes of Vibration-Mathematical Models - Displacement, velocity and Acceleration - Classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration - Single Degree Freedom Systems - Vibration isolation - Determination of natural frequencies

UNIT II BASICS OF NOISE

Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT III INSTRUMENTATION FOR VIBRATION MEASUREMENT

Experimental Methods in Vibration Analysis.- Vibration Measuring Instruments - Selection of Sensors - Accelerometer Mountings - Vibration Exciters - Mechanical, Hydraulic, Electromagnetic and Electrodynamics – Frequency Measuring Instruments -. System Identification from Frequency Response -Testing for resonance and mode shapes

UNIT IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS

Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL

Specification of Vibration Limits - Vibration severity standards - Vibration as condition Monitoring Tool - Case Studies - Vibration Isolation methods - Dynamic Vibration Absorber - Need for Balancing - Static and Dynamic Balancing machines - Field balancing - Major sources of noise -Noise survey techniques - Measurement technique for vehicular noise - Road vehicles Noise standard - Noise due to construction equipment and domestic appliances - Industrial noise sources and its strategies - Noise control at the source - Noise control along the path - Acoustic Barriers -Noise control at the receiver -- Sound transmission through barriers - Noise reduction Vs Transmission loss - Enclosures

OUTCOMES:

On Completion of the course the student will be able to

- 1. apply the basic concepts of vibration in damped and undamped systems
- 2. apply the basic concepts of noise and to understand its effects on systems
- 3. select the instruments required for vibration measurement and its analysis
- 4. select the instruments required for noise measurement and its analysis.
- 5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:

- 1. Singiresu S. Rao, "Mechanical Vibrations", Pearson Education Incorporated, 2017.
- 2. Graham Kelly. Sand Shashidhar K. Kudari, "Mechanical Vibrations", Tata McGraw -Hill Publishing Com. Ltd., 2007.

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- 3. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa Publishing House, 2000.
- 4. William T. Thomson, "Theory of Vibration with Applications", Taylor & Francis, 2003.
- 5. G.K. Grover, "Mechanical Vibrations", Nem Chand and Bros., Roorkee, 2014.
- 6. A.G. Ambekar, "Mechanical Vibrations and Noise Engineering", PHI Learning Pvt. Ltd., 2014.
- 7. David A. Bies and Colin H. Hansen, "Engineering Noise Control Theory and Practice", Spon Press, London and New York, 2009.

P24OM524 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:

- To learn the present energy scenario and the need for energy conservation.
- To understand the different measures for energy conservation in utilities.
- Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
- To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
- To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement

UNIT I ENERGY SCENARIO

Primary energy resources - Sectorial energy consumption (domestic, industrial and other sectors), Energy pricing, Energy conservation and its importance, Energy Conservation Act-2001 and its features – Energy star rating.

UNIT II HEATING, VENTILLATION & AIR CONDITIONING

Basics of Refrigeration and Air Conditioning - COP / EER / SEC Evaluation - SPV system design & optimization for Solar Refrigeration.

UNIT III LIGHTING, COMPUTER, TV

Specification of Luminaries – Types – Efficacy – Selection & Application – Time Sensors – Occupancy Sensors - Energy conservation measures in computer - Television - Electronic devices.

UNIT IV ENERGY EFFICIENT BUILDINGS

Conventional versus Energy efficient buildings - Landscape design - Envelope heat loss and heat gain - Passive cooling and heating - Renewable sources integration.

UNIT V ENERGY STORAGE TECHNOLOGIES

Necessity & types of energy storage - Thermal energy storage - Battery energy storage, charging and discharging- Hydrogen energy storage & Super capacitors - energy density and safety issues – Applications.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- 1. Understand technical aspects of energy conservation scenario.
- 2. Energy audit in any type for domestic buildings and suggest the conservation measures.
- 3. Perform building load estimates and design the energy efficient landscape system.
- 4. Gain knowledge to utilize an appliance/device sustainably.
- 5. Understand the status and current technological advancement in energy storage field.

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TOTAL: 45 PERIODS



REFERENCES:

- 1. Yogi Goswami, Frank Kreith, Energy Efficiency and Renewable energy Handbook, CRC Press, 2016
- 2. ASHRAE Handbook 2020 HVAC Systems & Equipment
- 3. Paolo Bertoldi, Andrea Ricci, Anibal de Almeida, Energy Efficiency in Household Appliances and Lighting, Conference proceedings, Springer, 2001
- 4. David A. Bainbridge, Ken Haggard, Kenneth L. Haggard, Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows, Chelsea Green Publishing, 2011.
- 5. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from <u>www.energymanagertraining.com</u>)
- 6. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.
- 7. Robert Huggins, Energy Storage: Fundamentals, Materials and Applications, 2nd edition, Springer, 2015
- 8. Ru-shiliu, Leizhang, Xueliang sun, Electrochemical technologies for energy storage and conversion, Wiley publications, 2012.



P24OM525 ADDITIVE MANUFACTURING TPC 1 2 003

UNIT I INTRODUCTION

Need - Development - Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing, AM Process Chain- Classification - Benefits.

UNIT II **DESIGN FOR ADDITIVE MANUFACTURING**

CAD Model Preparation - Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation Customized Design and Fabrication - Case Studies.

UNIT III VAT POLYMERIZATION

Stereolithography Apparatus (SLA)- Materials -Process -Advantages Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION

Fused Deposition Modeling (FDM)- Process-Materials - Applications and Limitations. Sheet Lamination Process: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials- Application and Limitation - Bio-Additive Manufacturing Computer Aided Tissue Engineering (CATE) - Case studies

POWDER BASED PROCESS

Selective Laser Sintering (SLS): Process -Mechanism- Typical Materials and Application- Multi Jet Fusion - Basic Principle-- Materials- Application and Limitation - Three Dimensional Printing -Materials - Process - Benefits and Limitations. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters -Materials -Benefits -Applications.

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES

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Education and training - Automobile- pattern and mould - tooling - Building Printing-Bio Printing medical implants -development of surgical tools Food Printing -Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.

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TOTAL: 45 PERIODS

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REFERENCES:

- 1. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
- 2. Ian Gibson, David W. Rosen and Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126.
- 3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590
- 4. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
- 5. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.



LTPC P24OM526 ELECTRIC VEHICLE TECHNOLOGY

UNIT I **NEED FOR ELECTRIC VEHICLES**

History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II ELECTRIC VEHICLE ARCHITECHTURE

Electric vehicle types, layout and power delivery, performance - traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE

Batteries - types - lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultracapacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV ELECTRIC DRIVES AND CONTROL

Types of electric motors - working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor -drives and control, AC and Switch reluctance motor drives and control - Drive system efficiency - Inverters - DC and AC motor speed controllers

DESIGN OF ELECTRIC VEHICLES UNIT V

Materials and types of production, Chassis skate board design, motor sizing, power pack sizing, component matching, Ideal gear box - Gear ratio, torque-speed characteristics, Dynamic equation of vehicle motion, Maximum tractive effort - Power train tractive effort Acceleration performance, rated vehicle velocity - maximum gradability, Brake performance, Electronic control system, safety and challenges in electric vehicles. Case study of Nissan leaf, Toyota Prius, tesla model 3, and Renault Zoe cars. **TOTAL: 45 PERIODS**

REFERENCES:

- 1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition CRC Press, 2011.
- 2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
- 3. James Larminie, John Lowry, Electric Vehicle Technology Explained Wiley, 2003.
- 4. Ehsani, M, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005

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P24OM527

NEW PRODUCT DEVELOPMENT

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COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- 1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
- 2. Identfying opportunity and planning for new product design and development.
- 3. Conducting customer need analysis; and setting product specification for new product design and development.
- 4. Generating, selecting, and testing the concepts for new product design and development.
- 5. Appling the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCTDESIGN & DEVELOPMENT

Introduction - Characteristics of Successful Product Development - People involved in Product Design and Development - Duration and Cost of Product Development - The Challenges of Product Development - The Product Development Process - Concept Development: The Front-End Process - Adapting the Generic Product Development Process - Product Development Process Flows - Product Development Organizations.

UNIT II OPPORTUNITY DENTIFICATION & PRODUCT PLANNING

Opportunity Identification: Definition - Types of Opportunities - Tournament Structure of Opportunity Identification - Effective Opportunity Tournaments - Opportunity Identification Process - Product Planning: Four types of Product Development Projects - The Process of Product Planning.

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS

Identifying Customer Needs: The Importance of Latent Needs - The Process of Identifying Customer Needs. Product Specifications: Definition - Time of Specifications Establishment - Establishing Target Specifications - Setting the Final Specifications

UNIT IV CONCEPT GENERATION, SELECTION & TESTING

Concept Generation: Activity of Concept Generation - Structured Approach - Five step method of Concept Generation. Concept Selection: Methodology - Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing.

UNITV INDUSTRIAL DESIGN & PROTOTYPING

Industrial Design: Need and Impact-Industrial Design Process. Prototyping - Principles of Prototyping - Prototyping Technologies - Planning for Prototypes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- 1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
- 2. Identify opportunity and plan for new product design and development.
- 3. Conduct customer need analysis; and set product specification for new product design and development.
- 4. Generate, select, and test the concepts for new product design and development.
- 5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

1. Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development "McGraw-Hill Education; 7 edition, 2020.



REFERENCES:

- 1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
- 2. Rosenthal S., "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN1-55623-603-4.
- 3. Pugh.S, "Total Design Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.
- 4. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
- 5. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.



P24OT501 SUSTAINABLE MANAGEMENT L1

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TOTAL: 45 PERIODS

COURSE OBJECTIVES:

- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY

Management of sustainability -rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY

Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES

Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION

Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS

Energy management, Water management, Waste management, Wild Life Conservation, Emerging trends in sustainable management, Case Studies.

COURSE OUTCOMES:

- **CO1**: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
- CO2: An understanding of corporate sustainability and responsible Business Practices
- **CO3**: Knowledge and skills to understand, to measure and interpret sustainabilityperformances.
- **CO4**: Knowledge of innovative practices in sustainable business and community management
- CO5: Deep understanding of sustainable management of resources and commodities



REFERENCES:

- 1. Daddi, T., Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
- 2. Christian N. Madu, Handbook of Sustainability Management 2012
- 3. Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014
- 4. Margaret Robertson, Sustainability Principles and Practice, 2014
- 5. Peter Rogers, An Introduction to Sustainable Development, 2006



P24OT502

MICRO AND SMALL BUSINESS MANAGEMENT

COURSE OBJECTIVES

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS

Creation, Innovation, entrepreneurship and small business - Defining Small Business -Role of Owner - Manager - government policy towards small business sector -elements of entrepreneurship -evolution of entrepreneurship -Types of Entrepreneurship - social, civic, corporate - Business life cycle - barriers and triggers to new venture creation - process to assist start ups - small business and family business.

UNIT II CREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE **BUSINESS PLAN**

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business - importance of strategy formulation - management skills for small business creation and development.

UNIT III **BUILDING THE RIGHT TEAM AND MARKETING STRATEGY**

Management and Leadership - employee assessments - Tuckman's stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS

Main sources of entrepreneurial capital; Nature of 'bootstrap' financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin-Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

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TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1. Familiarise the students with the concept of small business

CO2. In depth knowledge on small business opportunities and challenges

CO3. Ability to devise plans for small business by building the right skills and marketing strategies

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- CO4. Identify the funding source for small start ups
- CO5. Business evaluation for buying and selling of small firms

REFERENCES

- 1. Hankinson,A.(2000). "The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000." Industrial and Commercial Training 32(3):94-98.
- 2. Parker, R. (2000). "Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia." Australian Journal of Political Science 35(2):239-253.
- 3. Journal articles on SME's.



P24OT503 INTELLECTUAL PROPERTY RIGHTS L T P C 3 0 0 3

COURSE OBJECTIVE

> To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION

Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS

New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES

International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY

Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS

The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Understanding of intellectual property and appreciation of the need to protect it

CO2: Awareness about the process of patenting

CO3: Understanding of the statutes related to IPR

CO4: Ability to apply strategies to protect intellectual property

CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES

- 1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
- 2. Intellectual Property rights and copyrights, EssEss Publications.
- 3. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company.
- 4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006.
- 5. WIPO Intellectual Property Hand book.

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P24OT504

ETHICAL MANAGEMENT

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COURSE OBJECTIVE

To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY

Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society's expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS

Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT

Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANJAGEMENT

Understanding individual variables in ethics, managerial ethics, concepts in ethical psychologyethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decisionmaking and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS

Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Role modelling and influencing the ethical and cultural context.

CO2: Respond to ethical crises and proactively address potential crises situations.

- CO3: Understand and implement stakeholder management decisions.
- CO4: Develop the ability, knowledge, and skills for ethical management.

CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

- 1. Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016.
- 2. Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.
- 3. Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.

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P24OE513

IOT FOR SMART SYSTEMS

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COURSE OBJECTIVES:

- 1. To study about Internet of Things technologies and its role in real time applications.
- 2. To introduce the infrastructure required for IoT
- 3. To familiarize the accessories and communication techniques for IoT.
- 4. To provide insight about the embedded processor and sensors required for IoT
- 5. To familiarize the different platforms and Attributes for IoT

UNIT I INTRODUCTION TO INTERNET OF THINGS

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT PROTOCOLS:

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV IOT PROCESSORS

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT V CASE STUDIES

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Analyze the concepts of IoT and its present developments.

- CO2: Compare and contrast different platforms and infrastructures available for IoT
- CO3: Explain different protocols and communication technologies used in IoT
- CO4: Analyze the big data analytic and programming of IoT

CO5: Implement IoT solutions for smart applications

REFERENCES:

- 1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach "Internet of Things", Universities Press 2015.
- 2. Oliver Hersent, David Boswarthick and Omar Elloumi "The Internet of Things", Wiley, 2016.
- 3. Samuel Greengard, "The Internet of Things", The MIT press, 2015.
- 4. Adrian McEwen and Hakim Cassimally"Designing the Internet of Things "Wiley, 2014.
- 5. Jean- Philippe Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP: The Next Internet" Morgan Kuffmann Publishers, 2010.
- 6. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
- 7. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.



- 8. OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
- 9. Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
- 10. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
- 11. Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
- 12. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley, 2015.
- 13. UpenaDalal,"Wireless Communications & Networks, Oxford, 2015.



P240E514

MACHINE LEARNING AND DEEP LEARNING

L T P C 3 0 0 3

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COURSE OBJECTIVES:

The course is aimed at

- 1. Understanding about the learning problem and algorithms
- 2. Providing insight about neural networks
- 3. Introducing the machine learning fundamentals and significance
- 4. Enabling the students to acquire knowledge about pattern recognition.
- 5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL: 45 PERIODS

COURSE OUTCOMES (CO):

At the end of the course the student will be able to

- CO1 : Illustrate the categorization of machine learning algorithms.
- CO2: Compare and contrast the types of neural network architectures, activation functions
- CO3: Acquaint with the pattern association using neural networks
- CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
- CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:

- 1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
- 2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
- 3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.

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- 4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
- 5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.



P24OE515 RENEWABLE ENERGY TECHNOLOGY

L T P C 3 0 0 3

OBJECTIVES:

To impart knowledge on

- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION

Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO₂ Emission - importance of renewable energy sources, Potentials - Achievements- Applications.

UNIT II SOLAR PHOTOVOLTAICS

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell-characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT III PHOTOVOLTAIC SYSTEM DESIGN

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:

After completion of this course, the student will be able to:

- **CO1**: Demonstrate the need for renewable energy sources.
- **CO2**: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
- **CO3**: Design a stand-alone and Grid connected PV system.
- **CO4**: Analyze the different configurations of the wind energy conversion systems.
- CO5: Realize the basic of various available renewable energy sources

REFERENCES:

- 1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 2009.
- 2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
- 3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
- 4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.
- 5. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006
- 6. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
- 7. B.H.Khan, "Non-conventional Energy sources", McGraw-hill, 2nd Edition, 2009.

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8. Fang Lin Luo Hong Ye, "Renewable Energy systems", Taylor & Francis Group, 2013.



P24EM133

SMART GRID

LT P C 3003

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COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:

Students able to

CO1: Relate with the smart resources, smart meters and other smart devices.

- CO2: Explain the function of Smart Grid.
- CO3: Experiment the issues of Power Quality in Smart Grid.
- CO4: Analyze the performance of Smart Grid.

CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

- 1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
- 2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
- 3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
- 4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014
- 5. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.





SECURITY PRACTICES

LT PC 3 0 0 3

COURSE OBJECTIVES:

P24OC517

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY

Model of network security - Security attacks, services and mechanisms - OSI security architecture -A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

UNIT II NETWORK SECURITY

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY

Cyber Forensics- Disk Forensics - Network Forensics - Wireless Forensics - Database Forensics – Malware Forensics - Mobile Forensics - Email Forensics- Best security practices for automate Cloud infrastructure management - Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the core fundamentals of system security

- **CO2:** Apply the security concepts to wired and wireless networks
- **CO3**: Implement and Manage the security essentials in IT Sector
- **CO4:** Explain the concepts of Cyber Security and Cyber forensics

CO5: Be aware of Privacy and Storage security Issues.

REFERENCES

- 1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
- 2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
- 3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
- Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
- 5. John Sammons, "The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics", Syngress, 2012
- 6. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools",2011 Syngress, ISBN: 9781597495875.

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7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.



P24OC518

CLOUD COMPUTING TECHNOLOGIES

LT PC 3003

COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing. •
- To explore the roster of AWS services and illustrate the way to make applications in AWS •
- To gain knowledge in the working of Windows Azure and Storage services offered by • Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE

Basics of Virtual Machines - Process Virtual Machines - System Virtual Machines - Emulation -Interpretation - Binary Translation - Taxonomy of Virtual Machines. Virtualization -Management Virtualization – Hardware Maximization - Architectures - Virtualization Management - Storage Virtualization - Network Virtualization- Implementation levels of virtualization - virtualization structure - virtualization of CPU, Memory and I/O devices - virtual clusters and Resource Management - Virtualization for data center automation 12

UNIT II CLOUD PLATFORM ARCHITECTURE

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community - Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design - Layered cloud Architectural Development -Architectural Design Challenges

AWS CLOUD PLATFORM - IAAS UNIT III

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

UNIT V **PROGRAMMING MODEL**

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job -Developing Map Reduce Applications - Design of Hadoop file system -Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

COURSE OUTCOMES:

CO1: Employ the concepts of virtualization in the cloud computing

- **CO2:** Identify the architecture, infrastructure and delivery models of cloud computing
- **CO3:** Develop the Cloud Application in AWS platform
- **CO4:** Apply the concepts of Windows Azure to design Cloud Application
- **CO5:** Develop services using various Cloud computing programming models.

REFERENCES

- 1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
- 2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
- 3. Sriram Krishnan, Programming: Windows Azure, O'Reilly, 2010.

TOTAL: 45 PERIODS

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- 4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
- 5. Danielle Ruest, Nelson Ruest, Virtualization: A Beginner"s Guide∥, McGraw-Hill Osborne Media, 2009.
- 6. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
- 7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
- 8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
- 9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.



Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

P24OC519

DESIGN THINKING

L T P C 3 0 0 3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I UX LIFECYCLE TEMPLATE

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

UNIT II CONTEXTUAL INQUIRY

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING

Design-informing models: second span of the bridge. Some general "how to" suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

UNIT IV UX GOALS, METRICS, AND TARGETS

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

UNIT V ANALYSING USER EXPERIENCE

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting. Creating a User Experience Dashboard.

SUGGESTED ACTIVITIES:

1: Hands on Design Thinking process for a product

2: Defining the Look and Feel of any new Project

3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)

4: Identify a customer problem to solve.

5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Build UI for user Applications

CO2: Use the UI Interaction behaviors and principles

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- **CO3:** Evaluate UX design of any product or application
- **CO4:** Demonstrate UX Skills in product development
- **CO5:** Implement Sketching principles

REFERENCES

- 1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work, Westley Knight. Apress, 2018
- 2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012
- 3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018
- 4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
- 5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017



P24OC520

PRINCIPLES OF MULTIMEDIA

LT P C 3003

COURSE OBJECTIVES:

- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

Introduction to Multimedia - Characteristics of Multimedia Presentation - Multimedia Components - Promotion of Multimedia Based Components - Digital Representation - Media and Data Streams - Multimedia Architecture - Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

Suggested Activities:

- 1. Flipped classroom on media Components.
- 2. External learning Interactive presentation.

Suggested Evaluation Methods:

- 1. Tutorial Handling media components
- 2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations - data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio - Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:

- 1. Flipped classroom on different file formats of various media elements.
- 2. External learning Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

- 1. Demonstration on after effects animations.
- 2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS

Authoring Tools - Features and Types - Card and Page Based Tools - Icon and Object Based Tools - Time Based Tools - Cross Platform Authoring Tools - Editing Tools - Painting and Drawing Tools - 3D Modeling and Animation Tools - Image Editing Tools - Sound Editing Tools - Digital Movie Tools.

Suggested Activities:

- 1. Flipped classroom on multimedia tools.
- 2. External learning Comparison of various authoring tools.

Suggested Evaluation Methods:

- 1. Tutorial Audio editing tool.
- 2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard - JPEG 2000, basic audio compression - ADPCM, MPEG Psychoacoustics, basic Video compression techniques - MPEG, H.26X - Multimedia Database System - User Interfaces - OS Multimedia Support - Hardware Support - Real Time Protocols - Play Back Architectures -

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Synchronization - Document Architecture - Hypermedia Concepts: Hypermedia Design - Digital Copyrights, Content analysis.

Suggested Activities:

- 1. Flipped classroom on concepts of multimedia hardware architectures.
- 2. External learning Digital repositories and hypermedia design.

Suggested Evaluation Methods:

- 1. Quizzes on multimedia hardware and compression techniques.
- 2. Tutorial Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS 9

ADDIE Model - Conceptualization - Content Collection - Storyboard-Script Authoring Metaphors -Testing - Report Writing - Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing - social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

Suggested Activities:

- 1. External learning Game consoles.
- 2. External learning VRML scripting languages.

Suggested Evaluation Methods:

- 1. Demonstration of simple interactive games.
- 2. Tutorial Simple VRML program.

COURSE OUTCOMES:

CO1:Handle the multimedia elements effectively.

CO2:Articulate the concepts and techniques used in multimedia applications.

CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.

CO4:Design and implement algorithms and techniques applied to multimedia objects.

C05:Design and develop multimedia applications following software engineering models.

REFERENCES:

- 1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, "Fundamentals of Multimedia", Springer, Third Edition, 2021.
- 2. Prabhat K.Andleigh, Kiran Thakrar, "MULTIMEDIA SYSTEMS DESIGN", Pearson Education, 2015.
- 3. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018. (digital book)
- 4. Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw-Hill Education, 2017

TOTAL : 45 PERIODS



Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

P24OT505

BIG DATA ANALYTICS

L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA

Introduction to Big Data Platform - Challenges of Conventional Systems - Intelligent data analysis -Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

UNIT II SEARCH METHODS AND VISUALIZATION

Search by simulated Annealing - Stochastic, Adaptive search by Evaluation - Evaluation Strategies -Genetic Algorithm - Genetic Programming - Visualization - Classification of Visual Data Analysis Techniques - Data Types - Visualization Techniques - Interaction techniques - Specific Visual data analysis Techniques

UNIT III MINING DATA STREAMS

Introduction To Streams Concepts - Stream Data Model and Architecture - Stream Computing -Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments - Counting Oneness in a Window - Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions

UNIT IV FRAMEWORKS

MapReduce - Hadoop, Hive, MapR - Sharding - NoSQL Databases - S3 - Hadoop Distributed File Systems - Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V R LANGUAGE

Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists -Data frames -Classes, Input/output, String manipulations

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1:understand the basics of big data analytics

CO2: Ability to use Hadoop, Map Reduce Framework.

CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.

CO4:gain knowledge on R language

CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

REFERENCE:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.

3. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.

4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.

5. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

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Meenakshi Sundararajan Engineering College (An Autonomous Institution, Affiliated to Anna University, Chennai)

Department: M E, Construction Engineering And Management, R2024, CBCS

P24OT506

INTERNET OF THINGS AND CLOUD

LT PC 3 0 0 3

COURSE OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I FUNDAMENTALS OF IOT

Introduction to IoT - IoT definition - Characteristics - IoT Complete Architectural Stack - IoT enabling Technologies - IoT Challenges. Sensors and Hardware for IoT - Hardware Platforms - Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II PROTOCOLS FOR IoT

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS

Case studies with architectural analysis: IoT applications - Smart City - Smart Water - Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail - Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION

Introduction to Cloud Computing - Service Model - Deployment Model- Virtualization Concepts - Cloud Platforms - Amazon AWS - Microsoft Azure - Google APIs.

UNIT V IOT AND CLOUD

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Understand the various concept of the IoT and their technologies.

CO2: Develop IoT application using different hardware platforms

CO3: Implement the various IoT Protocols

CO4: Understand the basic principles of cloud computing.

CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

- 1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
- 2. Adrian McEwen, Designing the Internet of Things, Wiley, 2013.
- 3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
- 4. Simon Walkowiak, "Big Data Analytics with R" PackT Publishers, 2016
- 5. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.

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P24OT507

MEDICAL ROBOTICS

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TOTAL:45 PERIODS

COURSE OBJECTIVES:

- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS

Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning

Variable speed arrangements, Path determination - Machinery vision, Ranging - Laser - Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III SURGICAL ROBOTS

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS

Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS

Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human-robot cognitive interaction (cHRI), Human-robot physical interaction (pHRI), Wearable Robotic Communication - case study

COURSE OUTCOMES:

CO1: Describe the configuration, applications of robots and the concept of grippers and actuators

- **CO2:** Explain the functions of manipulators and basic kinematics **CO3:** Describe the application of robots in various surgeries
- **CO4:** Design and analyze the robotic systems for rehabilitation
- **CO5:** Design the wearable robots

REFERENCES

- 1. Nagrath and Mittal, "Robotics and Control", Tata McGraw Hill, First edition, 2003
- 2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008
- 3. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, "Robotics, control", sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008
- 4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, 1st Edition, Springer, 2008



- Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation Current State of the Art and 5. Recent Advances, Springer, 2016
- 6. Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
- Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, 7. England, 2008
- Howie Choset, Kevin Lynch, Seth Hutchinson, "Principles of Robot Motion: Theory, 8. Algorithms, and Implementations", Prentice Hall of India, First edition, 2005 Philippe Coiffet, Michel Chirouze, "An Introduction to Robot Technology", Tata McGraw Hill,
- 9. First Edition, 1983
- 10. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011
- 11. Jocelyn Troccaz, Medical Robotics, Wiley, 2012
- 12. Achim Schweikard, Floris Ernst, Medical Robotics, Springer, 2015



P24OT508

EMBEDDED AUTOMATION

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COURSE OBJECTIVES:

- To learn about the process involved in the design and development of real-time embedded • system
- To develop the embedded C programming skills on 8-bit microcontroller •
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming •
- To build a home automation system •

UNIT I INTRODUCTION TO EMBEDDED C PROGRAMMING

C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures -**Development Tools**

UNIT II AVR MICROCONTROLLER

ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES UNIT III CONTROLLERS

Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O -Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT IV **VISION SYSTEM**

Fundamentals of Image Processing - Filtering - Morphological Operations - Feature Detection and Matching - Blurring and Sharpening - Segmentation - Thresholding - Contours - Advanced Contour Properties - Gradient - Canny Edge Detector - Object Detection - Background Subtraction

UNIT V HOME AUTOMATION

Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor -Proximity Garage Door Opener - Vision Based Authentic Entry System

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: analyze the 8-bit series microcontroller architecture, features and pin details

CO2: write embedded C programs for embedded system application

CO3: design and develop real time systems using AVR microcontrollers

CO4: design and develop the systems based on vision mechanism

CO5: design and develop a real time home automation system

REFERENCES:

- 1. Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", McGraw-Hill, 2001.
- 2. Joe Pardue, "C Programming for Microcontrollers", Smiley Micros, 2005.
- 3. Steven F. Barrett, Daniel J. Pack, "ATMEL AVR Microcontroller Primer : Programming and Interfacing", Morgan & Claypool Publishers, 2012
- 4. Mike Riley, "Programming Your Home Automate With Arduino, Android and Your Computer", the Pragmatic Programmers, Llc, 2012.

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- 5. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
- 6. Kevin P. Murphy, "Machine Learning a Probabilistic Perspective", the MIT Press Cambridge, Massachusetts, London, 2012.



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P24OT509 VIRONMENTAL SUSTAINABILITY L T 3 0	P 0	C 3
UNIT IINTRODUCTIONValuingthe Environment: Concepts, Valuing the Environment: Methods, PropertyExternalities, and Environmental Problems	Rig	9 Jhts,
UNIT II CONCEPT OF SUSTAINABILITY Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture	÷	9
UNIT III SIGNIFICANCE OF BIODIVERSITY Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Poll Acid Rain and Atmospheric Modification, Transportation	utio	9 n,
UNIT IV POLLUTION IMPACTS Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, C Warming.	Job	9 al
UNIT V ENVIRONMENTAL ECONOMICS Development, Poverty, and the Environment, Visions of the Future, Environmental economic policy by Tom Tietenberg, Environmental Economics TOTAL : 45 PER	:s ar RIOE	9 nd DS
 REFERENCES Andrew Hoffman, Competitive Environmental Strategy - A Guide for the Changing Bus Landscape, Island Press. Stephen Doven, Environment and Sustainability Policy: Creation, Implementation, Evaluation, the Federation Press, 2005 Robert Brinkmann., Introduction to Sustainability, Wiley-Blackwell., 2016 Niko Roorda., Fundamentals of Sustainable Development, 3rd Edn, Routledge, 2020 	sine	SS

kshi., Sustainable Engineering: Principles and Practice, Cambridge University Press, 2019



TEXTILE REINFORCED COMPOSITES P24OT510 LTPC 3003

UNIT I REINFORCEMENTS

Introduction - composites -classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II MATRICES

Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III **COMPOSITE MANUFACTURING**

Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV TESTING

Fibre volume and weight fraction, specif ic gravity of composites, tensile, f lexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS

Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

REFERENCES

- 1. BorZ.Jang, "Advanced Polymer composites", ASM International, USA, 1994.
- 2. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials", SecondEdition, CRCPress, NewJersey, 1996.
- George LubinandStanley T.Peters, "Handbook of Composites", Springer Publications, 1998. 3.
- 4. Mel. M. Schwartz, "Composite Materials", Vol. 1 &2, Prentice Hall PTR, New Jersey, 1997.
- RichardM.Christensen, "Mechanics of compositematerials", DoverPublications, 2005. 5.
- 6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering", CRCPress, 2001

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P24OT511 NANOCOMPOSITE MATERIALS LTPC 3003

UNIT I **BASICS OF NANOCOMPOSITES**

Nomenclature, Properties, features and processing of nanocomposites. Sample Preparation and Characterization of Structure and Physical properties. Designing, stability and mechanical properties and applications of super hard nanocomposites.

UNIT II METAL BASED NANOCOMPOSITES

Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES

Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS

Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY

Nanocomposite membrane structures- Preparation and applications. Nanotechnology in Textiles and Cosmetics-Nano-fillers embedded polypropylene fibers - Soil repellence, Lotus effect - Nano finishing in textiles (UV resistant, anti-bacterial, hydrophilic, self-cleaning, flame retardant finishes), Sun-screen dispersions for UV protection using titanium oxide - Colour cosmetics. Nanotechnology in Food Technology - Nanopackaging for enhanced shelf life - Smart/Intelligent packaging.

TOTAL: 45 PERIODS

REFERENCES:

- 1. Introduction to Nanocomposite Materials. Properties, Processing, Characterization-Thomas E. Twardowski. 2007. DEStech Publications. USA.
- 2. Nanocomposites Science and Technology P. M. Ajayan, L.S. Schadler, P. V.Braun 2006.
- 3. Physical Properties of Carbon Nanotubes- R. Saito 1998.
- 4. Carbon Nanotubes (Carbon, Vol 33) M. Endo, S. lijima, M.S. Dresselhaus 1997.
- 5. The search for novel, superhard materials- Stan Vepriek (Review Article) JVST A, 1999
- 6. Nanometer versus micrometer-sized particles-Christian Brosseau, Jamal BeN Youssef, Philippe Talbot, Anne-Marie Konn, (Review Article) J. Appl. Phys, Vol 93, 2003
- 7. Diblock Copolymer, Aviram (Review Article), Nature, 2002
- 8. Bikramjit Basu, Kantesh Balani Advanced Structural Ceramics, A John Wiley & Sons, Inc.,

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9. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006

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P24OT512 IPR, BIOSAFETY AND ENTREPRENEURSHIP

LT PC 3 0 0 3

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UNIT I IPR

Intellectual property rights - Origin of the patent regime - Early patents act & Indian pharmaceutical industry - Types of patents - Patent Requirements - Application preparation filing and prosecution – Patentable subject matter - Industrial design, Protection of GMO's IP as a factor in R&D,IP's of relevance to biotechnology and few case studies.

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

History of GATT Agreement - Madrid Agreement - Hague Agreement - WIPO Treaties - Budapest Treaty - PCT - Ordinary - PCT - Conventional - Divisional and Patent of Addition - Specifications - Provisional and complete - Forms and fees Invention in context of "prior art" - Patent databases - Searching International Databases - Country-wise patent searches (USPTO,espacenet(EPO) -PATENT Scope (WIPO) - IPO, etc National & PCT filing procedure - Time frame and cost - Status of the patent applications filed - Precautions while patenting - disclosure/non-disclosure - Financial assistance for patenting - Introduction to existing schemes Patent licensing and agreement Patent infringement - Meaning, scope, litigation, case studies

UNIT III BIOSAFETY

Introduction - Historical Backround - Introduction to Biological Safety Cabinets - Primary Containment for Biohazards - Biosafety Levels - Biosafety Levels of Specific Microorganisms - Recommended Biosafety Levels for Infectious Agents and Infected Animals - Biosafety guidelines - Government of India.

UNIT IV GENETICALLY MODIFIED ORGANISMS

Definition of GMOs & LMOs - Roles of Institutional Biosafety Committee - RCGM - GEAC etc. for GMO applications in food and agriculture - Environmental release of GMOs - Risk Analysis - Risk Assessment - Risk management and communication - Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

Introduction - Entrepreneurship Concept - Entrepreneurship as a career - Entrepreneurial personality - Characteristics of successful Entrepreneur - Factors affecting entrepreneurial growth - Entrepreneurial Motivation - Competencies - Mobility - Entrepreneurship Development Programmes (EDP) - Launching Of Small Enterprise - Definition, Characteristics - Relationship between small and large units - Opportunities for an Entrepreneurial career - Role of small enterprise in economic development - Problems of small scale industries - Institutional finance to entrepreneurs - Institutional support to entrepreneurs.

TOTAL: 45 PERIODS

REFERENCES

- 1. Bouchoux, D.E., "Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets for the Paralegal", 3rd Edition, Delmar Cengage Learning, 2008.
- 2. Fleming, D.O. and Hunt, D.L., "Biological Safety: Principles and Practices", 4th Edition, American Society for Microbiology, 2006.
- 3. Irish, V., "Intellectual Property Rights for Engineers", 2nd Edition, The Institution of Engineering and Technology, 2005.
- 4. Mueller, M.J., "Patent Law", 3rd Edition, Wolters Kluwer Law & Business, 2009.
- 5. Young, T., "Genetically Modified Organisms and Biosafety: A Background Paper for Decision- Makers and Others to Assist in Consideration of GMO Issues" 1st Edition, World Conservation Union, 2004.
- 6. S.S Khanka, "Entrepreneurial Development", S.Chand & Company LTD, New Delhi, 2007.

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