

ANNA UNIVERSITY, CHENNAI
NON AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS – 2021

M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT

CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the programme M E Construction Engineering & Management will

- PEO1** Excel in research or will succeed in Construction Engineering and Management profession in the government, public and private sector organizations.
- PEO2** Have a sound knowledge in statistics, project management and construction engineering fundamentals required for solving real time construction Engineering and Management problems using modern equipment and software tools.
- PEO3** Become entrepreneurs and develop processes and construction technologies through innovation, by integrating their knowledge in multidisciplinary management to meet the needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable.
- PEO4** Have professional and ethical attitude, effective communication skills, teamwork skills, leadership quality, multidisciplinary approach and an ability to relate Construction Engineering and Management issues in broader social context.
- PEO5** Have competence of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

2. PROGRAMME OUTCOMES (POs):

POs describe what students are expected to know or be able to do by the time of post-graduation from the program. The Program Outcomes of M.E Construction Engineering and Management are as follows:

The students will able to

- PO1:** An ability to independently carry out research/investigation and development work to solve practical problems.
- PO2:** An ability to write and present a substantial technical report/document.
- PO3:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Pos		Courses
PO 1	An ability to independently carry out research/investigation and development work to solve practical problems.	Modern Construction Materials, Advanced Construction Techniques, Contract Laws and Regulations, Digital Design and Construction, Quantitative Techniques in Management, Computer Applications in Construction Engineering and Planning, Resources Management in Construction, Sustainable Construction, Statistical Methods for Engineers, Project Formulation and Appraisal, Research Methodology and IPR Seminar/ Industrial Training & Thesis.

PO 2	An ability to write and present a substantial technical report/document.	Construction Management Studio Laboratory, Statistical Analysis For Construction Engineers, Advanced Construction Engineering and Experimental Techniques Laboratory, Industrial Training & Thesis.
PO 3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	Design of Energy Efficient Buildings, Project Safety Management, Environmental Impact Assessment For Construction Engineers, Shoring, Scaffolding and Formwork, Lean Construction Concepts, Tools & Practices, Construction Planning, Scheduling and Control, Quality control and assurance in construction, Supply chain management and Logistics in construction, Digital Design and Construction, Maintenance, Repair and Rehabilitation Of Structures.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Construction Engineering and Management will be able to

PSO1	Knowledge of Construction Engineering and Management discipline	In-depth knowledge in the construction management, engineering and technologies necessary to formulate, plan, schedule and execute construction projects.
PSO2	Critical analysis of Construction management problems and innovation	Critically analyze and solve construction engineering and management problems by applying the modern tools and concepts of Construction Engineering & Management and make innovative advances in theoretical and practical.
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	Conceptualize the problems in construction industry and develop appropriate solutions which are technically feasible and economically viable with due consideration of sustainability.

PEO / PO Mapping:

PEO	PO1	PO2	PO3	PSO1	PSO2	PSO3
I.	3	3	2	3	2	3
II.	3	2	2	3	2	2
III.	2	2	2	2	3	2
IV.	2	1	2	2	3	2
V.	3	3	3	2	2	3

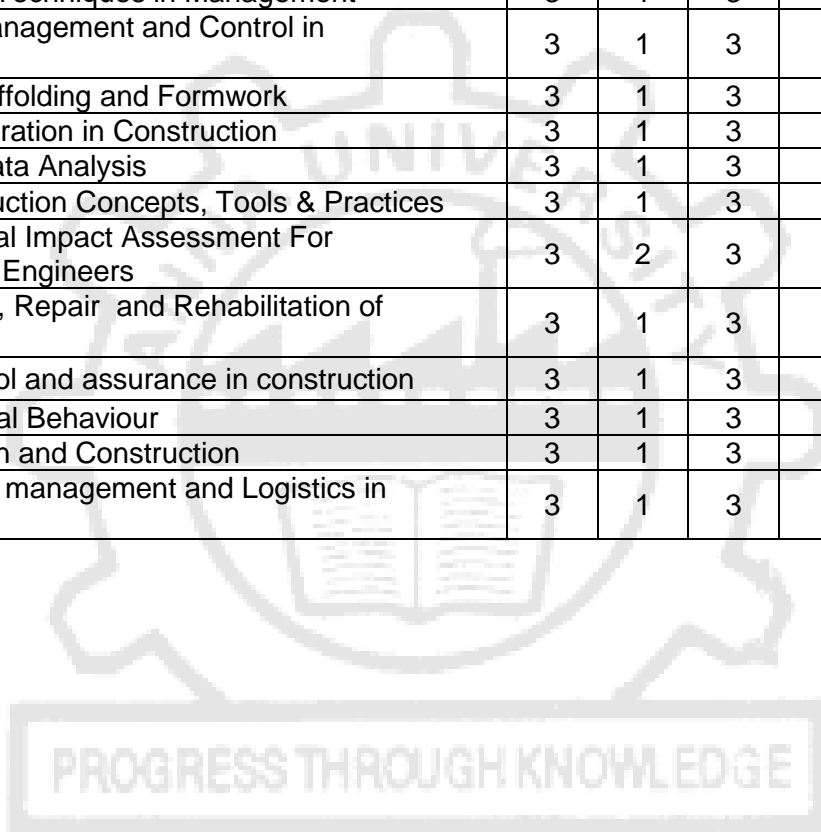
Mapping of Course Outcomes and Programme Outcomes

		Course Name	PO1	PO2	PO3	PSO1	PSO2	PSO3
YEAR I	SEMESTER I	Statistical Methods for Engineers	1.6	0.8	2.6	-	-	-
		Modern Construction Materials	3	1	2	2	1	3
		Project Formulation and Appraisal	2	1	3	3	1	2
		Construction Equipment and Management	3	1	2	3	2	3
		Professional Elective I	-	-	-	-	-	-
		Research Methodology and IPR	-	-	-	-	-	-
		Audit Course – I	-	-	-	-	-	-
		Advanced Construction Engineering and Experimental Techniques Laboratory	2	2	3	3	1	2
		Technical Seminar	2	3	2	3	2	3
	SEMESTER II	Advanced Construction Techniques	3	1	3	3	2	3
		Construction Planning, Scheduling and Control	3	1	3	3	2	3
		Contract Laws and Regulations	2	1	3	3	3	2
		Professional Elective II	-	-	-	-	-	-
		Professional Elective III	-	-	-	-	-	-
		Audit Course –II	-	-	-	-	-	-
		Construction Management Studio Laboratory	2	2	3	3	3	3
		Statistical Analysis for Construction Engineers	3	3	3	3	3	3
YEAR II	SEMESTER III	Professional Elective IV	-	-	-	-	-	-
		Professional Elective V	-	-	-	-	-	-
		Open Elective	-	-	-	-	-	-
		Practical Training (4 weeks)	3	3	3	3	2	2
		Project Work I	3	3	3	3	3	3
	SEMESTER IV	Project Work II	3	3	3	3	3	3

PROGRESS THROUGH KNOWLEDGE

PROFESSIONAL ELECTIVE COURSES (PEC)

S. NO.	COURSE TITLE	PO1	PO2	PO3	PSO1	PSO2	PSO3
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	3	2	3	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	3	1	3	3	1	1
10.	Resource Management and Control in Construction	3	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	3	1	3	2	2	1
17.	Quality control and assurance in construction	3	1	3	3	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



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CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABUS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4159	Statistical Methods for Engineers	FC	4	0	0	4	4
2.	CN4101	Modern Construction Materials	PCC	3	0	0	3	3
3.	CN4102	Project Formulation and Appraisal	PCC	3	1	0	4	4
4.	CN4103	Construction Equipment and Management	PCC	3	0	0	3	3
5.	RM4151	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
PRACTICALS								
8.	ST4161	Advanced Construction Engineering and Experimental Techniques Laboratory	PCC	0	0	4	4	2
9.	CN4111	Technical Seminar	EEC	0	0	2	2	1
TOTAL				20	1	6	27	22

* Audit Course is optional

SEMESTER II

S NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CN4201	Advanced Construction Techniques	PCC	3	0	0	3	3
2.	CN4202	Construction Planning, Scheduling and Control	PCC	3	0	0	3	3
3.	CN4203	Contract Laws 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
PRACTICALS								
7.	CN4211	Construction Management Studio Laboratory	PCC	0	0	4	4	2
8.	CN4212	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 NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
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
PRACTICALS								
4.	CN4311	Practical Training (4 Weeks)	EEC	0	0	0	0	2
5.	CN4312	Project Work I	EEC	0	0	12	12	6
TOTAL				9	0	12	21	17

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	CN4411	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	T	P		
1.	MA4159	Statistical Methods for Engineers	4	0	0	4	1

PROFESSIONAL CORE COURSES (PCC)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	CN4101	Modern Construction Materials	3	0	0	3	1
2.	CN4102	Project Formulation and Appraisal	3	1	0	4	1
3.	CN4103	Construction Equipment and Management	3	0	0	3	1
4.	ST4161	Advanced Construction Engineering and Experimental Techniques Laboratory	0	0	4	2	1
5.	CN4201	Advanced Construction Techniques	3	0	0	3	2
6.	CN4202	Construction Planning, Scheduling and Control	3	0	0	3	2
7.	CN4203	Contract Laws and Regulations	3	0	0	3	2
8.	CN4211	Construction Management Studio Laboratory	0	0	4	2	2
9.	CN4212	Statistical Analysis For Construction Engineers	0	0	4	2	2
TOTAL CREDITS						25	

LIST OF PROFESSIONAL ELECTIVE COURSES [PEC]**SEMESTER I, ELECTIVE I**

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CN4071	Advanced Concrete Technology	3	0	0	3	3
2.	CN4001	Human Resources Management in Construction	3	0	0	3	3
3.	CN4002	Construction Project Management	3	0	0	3	3
4.	CN4003	Sustainable Construction	3	0	0	3	3

SEMESTER II, ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CN4072	Economics and Finance Management in Construction	3	0	0	3	3
2.	CN4004	Design of Energy Efficient Buildings	3	0	0	3	3
3.	CN4005	Project Safety Management	3	0	0	3	3
4.	CN4006	Computer Applications in Construction Engineering and Planning	3	0	0	3	3

SEMESTER II, ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CN4007	Quantitative Techniques in Management	3	0	0	3	3
2.	CN4008	Resource Management and Control in Construction	3	0	0	3	3
3.	CN4009	Shoring, Scaffolding and Formwork	3	0	0	3	3
4.	CN4010	System Integration in Construction	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CN4011	Advanced Data Analysis	3	0	0	3	3
2.	CN4012	Environmental Impact Assessment For Construction Engineers	3	0	0	3	3
3.	CN4091	Lean Construction Concepts, Tools and Practices	3	0	0	3	3
4.	ST4073	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	3

SEMESTER III, ELECTIVE V

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CN4013	Quality Control and Assurance in Construction	3	0	0	3	3
2.	CN4014	Digital Design and Construction	3	0	0	3	3
3.	CN4074	Organizational Behaviour	3	0	0	3	3
4.	CN4092	Supply Chain Management and Logistics in Construction	3	0	0	3	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS						2	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	CN4111	Technical Seminar	0	0	2	1	1
2.	CN4311	Practical Training (4 weeks)	0	0	0	2	3
3.	CN4312	Project Work I	0	0	12	6	3
4.	CN4411	Project Work II	0	0	24	12	4
TOTALCREDITS						21	

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX4091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX4092	Disaster Management	2	0	0	0	
3.	AX4093	Constitution of India	2	0	0	0	
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0	

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	OIC431	Blockchain Technologies	3	0	0	3
2.	OIC432	Deep Learning	3	0	0	3
3.	OME431	Vibration and Noise Control Strategies	3	0	0	3
4.	OME432	Energy Conservation and Management in Domestic Sectors	3	0	0	3
5.	OME433	Additive Manufacturing	3	0	0	3
6.	OME434	Electric Vehicle Technology	3	0	0	3
7.	OME435	New Product Development	3	0	0	3
8.	OBA431	Sustainable Management	3	0	0	3
9.	OBA432	Micro and Small Business Management	3	0	0	3
10.	OBA433	Intellectual Property Rights	3	0	0	3
11.	OBA434	Ethical Management	3	0	0	3
12.	ET4251	IoT for Smart Systems	3	0	0	3
13.	ET4072	Machine Learning and Deep Learning	3	0	0	3
14.	PX4012	Renewable Energy Technology	3	0	0	3
15.	PS4093	Smart Grid	3	0	0	3
16.	CP4391	Security Practices	3	0	0	3
17.	MP4251	Cloud Computing Technologies	3	0	0	3
18.	IF4072	Design Thinking	3	0	0	3
19.	MU4153	Principles of Multimedia	3	0	0	3
20.	DS4015	Big Data Analytics	3	0	0	3
21.	NC4201	Internet of Things and Cloud	3	0	0	3
22.	MX4073	Medical Robotics	3	0	0	3
23.	VE4202	Embedded Automation	3	0	0	3
24.	CX4016	Environmental Sustainability	3	0	0	3
25.	TX4092	Textile Reinforced Composites	3	0	0	3
26.	NT4002	Nanocomposite Materials	3	0	0	3
27.	BY4016	IPR, Biosafety and Entrepreneurship	3	0	0	3

SUMMARY

S. No.	Name of the Programme: M.E CONSTRUCTION ENGINEERING AND MANAGEMENT					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	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	✓	✓	00	00	
	TOTAL CREDITS	22	19	17	12	70



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**12**

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

UNIT II TESTING OF HYPOTHESIS**12**

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**12**

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**12**

Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - 2^2 Factorial design.

UNIT V MULTIVARIATE ANALYSIS**12**

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 :

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

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	-	-	-

CN4101

MODERN CONSTRUCTION MATERIALS

L T P C
3 0 0 3

OBJECTIVE:

- 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

9

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 NON-STRUCTURAL MATERIALS, ASSOCESSORIES AND FINISHES

9

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

9

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.

UNIT IV SPECIAL CONCRETES

9

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

9

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

TOTAL: 45 PERIODS

OUTCOMES:

- 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 façade materials
CO5 Apply the knowledge of smart and intelligent materials in construction field

REFERENCES:

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

COs- PO’s & PSO’s MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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
CO5	3	1	3	1	1	1

CN4102

PROJECT FORMULATION AND APPRAISAL

L T P C

3 1 0 4

OBJECTIVE:

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

UNIT I PROJECT FORMULATION

12

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

12

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

12

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

12

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

12

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

TOTAL: 60 PERIODS

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:

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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4103**CONSTRUCTION EQUIPMENT AND MANAGEMENT****L T P C
3 0 0 3****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**9**

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**9**

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**9**

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.

UNIT IV ASPHALT AND CONCRETING EQUIPMENT 9

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 9

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

TOTAL: 45 PERIODS**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:

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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

RM4151**RESEARCH METHODOLOGY AND IPR**

L T P C
2 0 0 2

UNIT I RESEARCH DESIGN 6

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 6

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

UNIT III DATA ANALYSIS AND REPORTING 6
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 6
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 6
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, 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, Long Nguyen, Matthew Rodgers, "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.

ST4161 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

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4111

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	PSO1	PSO2	PSO3
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

CN4201**ADVANCED CONSTRUCTION TECHNIQUES****L T P C****3 0 0 3****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**9**

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**9**

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**9**

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**9**

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**9**

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, 2008.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

PROGRESS THROUGH KNOWLEDGE

CN4202**CONSTRUCTION PLANNING, SCHEDULING, AND CONTROL****L T P C
3 0 0 3****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**9**

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 9

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-Arrow 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 9

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 9

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 9

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 Charoengnam, 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, New York, 1985.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

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**9**

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**9**

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**9**

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**9**

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**9**

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
4. 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.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4211

CONSTRUCTION MANAGEMENT STUDIO LABORATORY

L T P C

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)

TOTAL: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**COs- PO's & PSO's MAPPING**

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

OBJECTIVE:

- 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
- CO5** Solve Construction management problems using decision making tool.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4312

PROJECT WORK I

L T P C
0 0 12 6

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.

COs- PO's & PSO's MAPPING

	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

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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

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**9**

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**9**

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**9**

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**9**

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**9**

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
 - CO1** Develop knowledge on various materials needed for concrete manufacture
 - 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:

- Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2017.
- Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2019.
- Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
- Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
- Job Thomas., Concrete Technology, Cengage learning India Private Ltd, New Delhi, 2015.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4001**HUMAN RESOURCES MANAGEMENT IN CONSTRUCTION****L T P C****3 0 0 3****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**9**

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**9**

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 9

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 9

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 9

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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

OBJECTIVE:

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

UNIT I FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT 9

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 9

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 9

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 9

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 9

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:

- Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 3rd Edition, 2014.
- Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 2017.
- Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2nd edition, 2000.
- Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 4th Edition, 2013.
- Kumar Neeraj Jha, Construction Project Management Theory and Practices, Pearson, 2012.

COs- PO's & PSO's MAPPING

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CO3	2	1	2	2	2	2
CO3	3	1	2	2	1	2

CN4003

SUSTAINABLE CONSTRUCTION

L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I INTRODUCTION

9

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

9

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

9

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

9

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

9

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.

TOTAL: 45 PERIODS

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.
- Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
- Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.

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

COs- PO's & PSO's MAPPING

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CO3	3	3	2	1	3	1
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CO3	3	1	2	2	3	2

CN4072 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION L T P C
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 9

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 9

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.

UNIT III EVALUATING ALTERNATIVE INVESTMENTS 9

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 9

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

UNIT V FUNDAMENTALS OF MANAGEMENT ACCOUNTING 9

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

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

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, 3rd Edn. Addison Wesley Education Publishers.,1998.
5. Steiner, H.M. Engineering Economic principles, 2nd Edn. McGraw Hill Book, 1996

COs- PO's & PSO's MAPPING

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CO1	1	1	1	3	3	1
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CO3	1	2	2	3	3	2
CO4	2	2	1	2	2	1
CO5	1	1	2	1	1	3

CN4004**DESIGN OF ENERGY EFFICIENT BUILDINGS****L T P C****3 0 0 3****OBJECTIVE:**

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

UNIT I INTRODUCTION**9**

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**9**

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**9**

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**9**

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 9

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.

TOTAL: 45 PERIODS

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.
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.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4005 PROJECT SAFETY MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

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

UNIT I CONSTRUCTION ACCIDENTS 9

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

UNIT II SAFETY PROGRAMMES 9

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

UNIT III CONTRACTUAL OBLIGATIONS 9
 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 9
 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 9
 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:

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

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CO4	1	1	2	2	2	2
CO5	1	1	2	2	2	2

CN4006 COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING

**L T P C
3 0 0 3**

OBJECTIVE:

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

UNIT I INTRODUCTION 9
 Overview of IT Applications in Construction – Construction process – Computerization in Construction – Computer-aided Cost Estimation – Developing applications with database software.

UNIT I	OPERATIONS RESEARCH	9
Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post–Optimality Analysis – Transportation and Assignment Problems.		
UNIT II	PRODUCTION MANAGEMENT	9
Inventory Control - EOQ Model - Quantity Discounts - Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.		
UNIT III	FINANCIAL MANAGEMENT	9
Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting.		
UNIT IV	DECISION THEORY	9
Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.		
UNIT V	MANAGERIAL ECONOMICS	9
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.

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CO4	2	1	2	3	3	3
CO5	1	1	2	3	3	3

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 9

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 9

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 9

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 9

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 9

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.

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CO5	2	2	2	3	2	2

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 9

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 9

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 9

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 9

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

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CO5	1	1	1	3	2	3

CN4010

SYSTEM INTEGRATION IN CONSTRUCTION

**L T P C
3 0 0 3**

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

9

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

UNIT II ENVIRONMENTAL FACTORS

9

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

9

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

UNIT IV MAINTENANCE

9

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

9

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.

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CO5	3	2	3	2	3	2

CN4011**ADVANCED DATA ANALYSIS****L T P C
3 0 0 3****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**9**

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

UNIT II BASIC CONCEPTS**9**

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**9**

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

UNIT I	INTRODUCTION	9
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	9
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	9
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	9
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	9
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.		

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 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 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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

CN4091 LEAN CONSTRUCTION CONCEPTS, TOOLS, AND PRACTICES**L T P C
3 0 0 3****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**9**

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**9**

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**9**

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**9**

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**9**

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.

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.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

ST4073 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

**L T P C
3 0 0 3**

OBJECTIVE:

- To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

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 9

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 9

Repair materials-Variou 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**9**

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

CO	PO			PSO		
	1	2	3	1	2	3
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

CN4013 QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION**L T P C****3 0 0 3****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 9

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 9

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 9

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 9

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 9

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.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

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**9**

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

UNIT II DEVELOPMENT OF DESIGN PROCESS**9**

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

UNIT III CHALLENGES IN BIM IMPLEMENTATION**9**

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

UNIT IV CONSTRUCTION AUTOMATION**9**

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

UNIT V MODERN DIGITAL TECHNOLOGIES IN CONSTRUCTION**9**

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

TOTAL: 45 PERIODS**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	PSO1	PSO2	PSO3
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

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 9
 Definition, need, and importance of organizational behaviour –Nature and scope –Frame work – Organizational behaviour models.

UNIT II INDIVIDUAL BEHAVIOUR 9
 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 9
 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 9
 Meaning –Importance–Leadership styles –Theories –Leaders Vs Managers –Sources of power – Power centers –Power and Politics.

UNIT V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR 9
 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. Fred Luthans, "Organisational Behavior", McGraw Hill, 12th Edition, 2005.
3. Schermerhorn, Hunt, and Osborn, "Organisational Behavior", John Wiley, 12th Edition, 2011.
4. Udai Pareek, "Understanding Organisational Behaviour", 2nd Edition, Oxford Higher Education, 2008.
5. Mc Shane & Von Glinov, "Organisational Behaviour", 6th Edition, Tata McGraw Hill, 2012.

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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

**CN4092 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 9

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 9

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 9

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 9

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

UNIT V LOGISTICS OPERATIONS 9

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.

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

COs- PO's & PSO's MAPPING

	PO1	PO2	PO3	PSO1	PSO2	PSO3
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



AUDIT COURSES

AX4091

ENGLISH FOR RESEARCH PAPER WRITING

L T P C
2 0 0 0

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

6

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

6

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

UNIT III TITLE WRITING SKILLS

6

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

6

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

6

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.

AX4092

DISASTER MANAGEMENT

L T P C
2 0 0 0

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 6

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 6

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 6

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 6

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 6

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.

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 Revolution in 1917 and 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.

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 ஔவையார்	
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 (617, 618) - இயமம் நியமம் விதிகள்	
	4. தர்மச்சாலையை நிறுவிய வள்ளலார்	
	5. புறநானூறு - சிறுவனே வள்ளலானான்	
	6. அகநானூறு (4) - வண்டு நற்றிணை (11) - நண்டு கலித்தொகை (11) - யானை, புறா ஐந்திணை 50 (27) - மான் ஆகியவை பற்றிய செய்திகள்	
UNIT V	நவீன தமிழ் இலக்கியம்	6
	1. உரைநடைத் தமிழ், - தமிழின் முதல் புதினம்,	

- தமிழின் முதல் சிறுகதை,
- கட்டுரை இலக்கியம்,
- பயண இலக்கியம்,
- நாடகம்.
- 2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
- 3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
- 4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
- 5. அறிவியல் தமிழ்,
- 6. இணையத்தில் தமிழ்,
- 7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - <https://ta.wikipedia.org>
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்



OPEN ELECTIVES

OIC431

BLOCKCHAIN TECHNOLOGIES

L T P C
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 9

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 9

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.

UNIT III INTRODUCTION TO ETHEREUM 9

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

UNIT IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10

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.

UNIT V BLOCKCHAIN APPLICATIONS 8

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

TOTAL: 45 PERIODS

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.

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**6**

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**9**

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**10**

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**10**

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 Co-occurrence 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**10**

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

TOTAL : 45 PERIODS**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

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**9**

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**9**

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**9**

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**9**

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**9**

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

TOTAL: 45 PERIODS**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.

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.

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

**L T P C
3 0 0 3**

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 9

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 9

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

UNIT III LIGHTING, COMPUTER, TV 9

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

UNIT IV ENERGY EFFICIENT BUILDINGS 9

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 9

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.

TOTAL: 45 PERIODS

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.

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 www.energymanagertraining.com)
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.

OME433

ADDITIVE MANUFACTURING

L T P C
3 0 0 3

UNIT I INTRODUCTION

9

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

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

9

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

UNIT III VAT POLYMERIZATION

9

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

9

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

9

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.

TOTAL: 45 PERIODS

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.

OME434

ELECTRIC VEHICLE TECHNOLOGY

L T P C
3 0 0 3

UNIT I NEED FOR ELECTRIC VEHICLES 9

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 ARCHITECTURE 9

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 9

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, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV ELECTRIC DRIVES AND CONTROL 9

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

UNIT V DESIGN OF ELECTRIC VEHICLES 9

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

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. Identifying 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. Applying the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT 9

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 IDENTIFICATION & PRODUCT PLANNING 9

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 9

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 9

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.

UNIT V INDUSTRIAL DESIGN & PROTOTYPING 9

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, ISBN0-202-41639-5.
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.

OBA431

SUSTAINABLE MANAGEMENT

**LT P C
3 0 0 3**

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 9

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 9

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 9

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 9

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 9

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

TOTAL: 45 PERIODS

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 sustainability performances.
- 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

OBA432

MICRO AND SMALL BUSINESS MANAGEMENT

L T P C
3 0 0 3

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 9

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 SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9

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 9

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 9

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 9

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.

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

- 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.

OBA433

INTELLECTUAL PROPERTY RIGHTS

L T P C
3 0 0 3

COURSE OBJECTIVE

- To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION

9

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

9

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

9

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

9

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

UNIT V MODELS

9

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.

COURSE OBJECTIVE

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

UNIT I ETHICS AND SOCIETY**9**

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**9**

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**9**

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 MANAGEMENT**9**

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

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS**9**

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.

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**9**

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

UNIT II IOT ARCHITECTURE**9**

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**9****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**9**

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

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

UNIT V CASE STUDIES**9**

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 VijaiMadiseti : 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. Ovidiu Vermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
9. Vijay Madiseti, Arshdeep Bahga, "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. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, "Smart Grid Technology and Applications", Wiley, 2015.
13. Upena Dalal, "Wireless Communications & Networks, Oxford, 2015.

ET4072

MACHINE LEARNING AND DEEP LEARNING

L T P C

3 0 0 3

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 9

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

UNIT II NEURAL NETWORKS 9

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 9

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 9

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 9

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.
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.

PX4012

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

9

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

9

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

9

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

9

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**9**

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

PS4093**SMART GRID****L T P C****3 0 0 3****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**9**

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**9**

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**9**

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 9
 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.

CP4391

SECURITY PRACTICES

**L T P C
3 0 0 3**

COURSE OBJECTIVES:

- 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 9
 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 9
 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 9
 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 9
 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 9
 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
4. 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.
7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.



MP4251

CLOUD COMPUTING TECHNOLOGIES

**L T P C
3 0 0 3**

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 6
 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

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**8**

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**10**

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**9**

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**8**

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**10**

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

- 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

MU4153

PRINCIPLES OF MULTIMEDIA

L T P C
3 0 0 3

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

9

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

9

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

9

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

9

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 – 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.

TOTAL : 45 PERIODS

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.

CO5: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

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 9

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 9

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 9

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 9

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 9

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.

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**9**

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**9**

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**9**

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**9**

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

UNIT V IoT AND CLOUD**9**

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.

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 9

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 9

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 9

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 9

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 9

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

TOTAL:45 PERIODS**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

5. Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances, Springer, 2016
6. Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
7. Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, England, 2008
8. Howie Choset, Kevin Lynch, Seth Hutchinson, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, First edition, 2005
9. Philippe Coiffet, Michel Chirouze, "An Introduction to Robot Technology", Tata McGraw Hill, 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

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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

9

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

9

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

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

9

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

9

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

9

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.
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.

CX4016

ENVIRONMENTAL SUSTAINABILITY

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UNIT I INTRODUCTION

9

Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II CONCEPT OF SUSTAINABILITY

9

Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III SIGNIFICANCE OF BIODIVERSITY

9

Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV POLLUTION IMPACTS

9

Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V ENVIRONMENTAL ECONOMICS

9

Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES

1. Andrew Hoffman, Competitive Environmental Strategy - A Guide for the Changing Business Landscape, Island Press.
2. Stephen Doven, Environment and Sustainability Policy: Creation, Implementation, Evaluation, the Federation Press, 2005
3. Robert Brinkmann., Introduction to Sustainability, Wiley-Blackwell., 2016
4. Niko Roorda., Fundamentals of Sustainable Development, 3rd Edn, Routledge, 2020
5. Bhavik R Bakshi., Sustainable Engineering: Principles and Practice, Cambridge University Press, 2019

UNIT I REINFORCEMENTS 9

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

UNIT II MATRICES 9

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

UNIT III COMPOSITE MANUFACTURING 9

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 9

Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS 9

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", Second Edition, CRC Press, New Jersey, 1996.
3. George Lubin and Stanley T. Peters, "Handbook of Composites", Springer Publications, 1998.
4. Mel. M. Schwartz, "Composite Materials", Vol. 1 & 2, Prentice Hall PTR, New Jersey, 1997.
5. Richard M. Christensen, "Mechanics of composite materials", Dover Publications, 2005.
6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering", CRC Press, 2001

PROGRESS THROUGH KNOWLEDGE

UNIT I BASICS OF NANOCOMPOSITES 9

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 9

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 9

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

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS 9

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 9

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. Iijima, M.S. Dresselhaus 1997.
5. The search for novel, superhard materials- Stan Vepřek (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.,
9. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006

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IPR, BIOSAFETY AND ENTREPRENEURSHIP

**L T P C
3 0 0 3**

UNIT I IPR 9

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 9

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**9**

Introduction – Historical Background – 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**9**

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 Cartagena Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT**9**

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.



PROGRESS THROUGH KNOWLEDGE