ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
M. E. INFRASTRUCTURE ENGINEERING AND MANAGEMENT
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABUS

SEMESTER I

S. NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4159	Statistical Methods for Engineers	FC	4	0	0	4	4
2.	IM4101	Project Management for Infrastructure	PCC	2	2	0	4	3
3.	IM4102	Urban Transportation Systems Planning	PCC	3	0	0	3	3
4.	IM4103	Infrastructure Planning and Management	PCC	3	0	0	3	3
5.	RM4151	Research Methodology and IPR	RMC	0	0	2	2	2
6.		Professional Elective I	PEC	3	0	0	3	3
7.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
8.	IM4111	BIM and Project Management Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**2**	**6**	**25**	**20**

*** Audit Course is optional**

SEMESTER II

S. NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IM4201	Infrastructure Contract Management	PCC	3	0	0	3	3
2.	IM4202	Geographical Information Systems and Infrastructure Planning	PCC	2	2	0	4	3
3.	IM4203	Geotechnical Engineering for Infrastructure	PCC	2	0	2	4	3
4.	IM4204	Advanced Structural Design	PCC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	0	3	3
6.		Professional Elective III	PEC	3	0	0	3	3
7.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
8.	IM4211	GIS Laboratory	PCC	0	0	4	4	2
9.	IM4212	Infrastructure Material Testing Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**2**	**10**	**30**	**22**

*** Audit Course is optional**

SEMESTER III

S. NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			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.	IM4311	Seminar	EEC	0	0	2	2	1
5.	IM4312	Industrial Training (4 weeks)	EEC	-	-	-	-	2
6.	IM4313	Project Work I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**14**	**23**	**18**

SEMESTER IV

S. NO.	COURSE CODE	COURSETITLE	CATE-GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	IM4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 72

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
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
			Lecture	Tutorial	Practical		
1.	IM4101	Project Management for Infrastructure	2	2	0	3	1
2.	IM4102	Urban Transportation Systems Planning	3	0	0	3	1
3.	IM4103	Infrastructure Planning and Management	3	0	0	3	1
4.	IM4111	BIM and Project Management Laboratory	0	0	4	2	1
5.	IM4201	Infrastructure Contract Management	3	0	0	3	2
6.	IM4202	Geographical Information Systems for Infrastructure Planning	2	2	0	3	2
7.	IM4203	Geo Technical Engineering for Infrastructure	2	0	2	3	2
8.	IM4204	Advanced Structural Design	3	0	0	3	2
9.	IM4211	GIS Laboratory	0	0	4	2	2
10.	IM4212	Infrastructure Material Testing Laboratory	0	0	4	2	2
					TOTAL CREDITS	**27**	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS						2	

LIST OF PROFESSIONAL ELECTIVES (PEC)

SEMESTER I, ELECTIVE I

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	ST4073	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	3
2.	IM4001	Material Procurement and Management	3	0	0	3	3
3.	CN4072	Economics and Finance Management in Construction	3	0	0	3	3
4.	CN4074	Organizational Behaviour	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.	IM4002	Management of Human Resource and Quality	3	0	0	3	3
2.	CN4075	Supply Chain Management and Logistics in Construction	3	0	0	3	3
3.	CN4073	Lean Construction Concepts, Tools and Practices	3	0	0	3	3
4.	IM4003	Value Engineering	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.	IM4004	Safety in Construction Engineering	3	0	0	3	3
2.	ST4072	Design of Bridge Structures	3	0	0	3	3
3.	IM4005	Modern Construction Material and Technology	3	0	0	3	3
4.	ST4071	Advanced Prestressed Concrete	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.	IM4006	Environmental Impact Assessment for Infrastructure Projects	3	0	0	3	3
2.	IM4007	Urban Environmental Management	3	0	0	3	3
3.	IM4008	Life Cycle Analysis and Design for the Environment	3	0	0	3	3
4.	IM4009	Sustainable Development and Urban Planning	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.	IM4010	Infrastructure for SMART City Planning	3	0	0	3	3
2.	IM4011	Pavement Management System	3	0	0	3	3
3.	IM4012	Airport System Planning and Design	3	0	0	3	3
4.	IM4013	Urban Infrastructure and Asset Management	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IM4311	Seminar	0	0	2	1	3
2.	IM4312	Industrial training (4 weeks)	-	-	-	2	3
3.	IM4313	Project Work I	0	0	12	6	3
4.	IM4411	Project Work II	0	0	24	12	4
					TOTAL CREDITS	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	

SUMMARY

	Name of the Programme: M.E. Infrastructure Engineering and Management					
	SUBJECT AREA	**CREDITS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1.	FC	04	00	00	00	04
2.	PCC	11	16	00	00	27
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	00	09	12	21
7.	Non Credit/Audit Course	✓	✓			
8.	**TOTAL CREDIT**	**20**	**22**	**18**	**12**	**72**

MA4159 **STATISTICAL METHODS FOR ENGINEERS** **L T P C**
4 0 0 4

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 :

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

IM4101 PROJECT MANAGEMENT FOR INFRASTRUCTURE L T P C
2 2 0 3

OBJECTIVES :

- To Understand and Explain Project Management Process, Project Planning and Time Management, Organizing for Project Management, Resource Planning and Cost Estimation.

UNIT I PROJECT MANAGEMENT - AN OVERVIEW: 6+6

Introduction, Project Management process, Project Management techniques, Relationship to other management disciplines, Related endeavors, Concentric project management, Project formulation and development

UNIT II PROJECT PLANNING AND TIME MANAGEMENT: 6+6

Purpose, Project scheduling, activity definition, activity sequencing, activity duration estimating, schedule development, schedule control, project management using CPM\PERT- Network basics, Network development, PERT analysis, advantages. Computerized network analysis- features of PM software, capabilities of PM software, multi project analysis,

UNIT III ORGANIZING FOR PROJECT MANAGEMENT: 6+6

Project Management – modern trends - Strategic Planning - Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team.

UNIT IV RESOURCE PLANNING: 6+6

Introduction, Inputs, Tools, Outputs, Resource scheduling, Resource leveling, Resource restrained scheduling, strategies for shortening the schedule Assigning resources: Work, duration, resources, Effort driven scheduling, create a resource list, Exercise on resource planning using software, Level now command, leveling Gantt chart, assigning rate to resources, techniques of duration cost trade-off.

UNIT V COST ESTIMATION: 6+6

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Estimation of Operating Costs.

TOTAL: 60 PERIODS

OUTCOMES:

CO1 Explain project, project management, life cycle and project formulation
CO2 Analyze and Manage time in projects through Gantt charts, and network techniques.
CO3 Analyze and manage time in projects through CPM and PERT, update and monitor projects
CO4 Optimize resources of projects using scheduling, fast tracking and re-estimation techniques
CO5 Explain different approaches for estimating cost

REFERENCES:

1. Harold Kerzner – Project Management – systems approach to planning, scheduling & controlling – 7th edition, John wiley & sons, Canada.
2. Microsoft Project for Windows 2000 –Microsoft Press, USA 2000.
3. Tim Pyron – Microsoft Project 2000 in 24 hours – Sama Teach ypurself series- Techmedia Published New Delhi.
4. Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998.
5. Choudhury S , "Project Management", McGraw-Hill Publishing Company, New Delhi, 1988.

6. Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders", Prentice Hall, Pittsburgh, 2000.
7. Frederick E. Gould,"Construction Project Management", Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.
8. George J.Ritz , "Total Construction Project Management" - McGraw-Hill Inc, 1994.

IM4102 URBAN TRANSPORTATION SYSTEMS PLANNING L T P C
3 0 0 3

OBJECTIVES:

- To make the leaners to understand and explain the principles of the transportation system planning, covering both passenger and freight transports and the methodology of effective management of transport systems.

UNIT I INTRODUCTION 9

Introduction and concepts; demand for transport – nature of demand, temporal and special variations; factors influencing demand for transport; effect of land use and socioeconomic activities on the demand; conceptual difference between urban, interurban and regional transport planning processes; Interaction of land-use and transport planning processes; urban transport planning process (morphology).

UNIT II TRIP GENERATION AND DISTRIBUTION 9

Trip production process; household characteristics; classification based on trip purpose – trips for work, education, shopping, social and recreational purposes; influencing variables of trips made for different purposes; modelling trip production. Trip attraction process; attraction of trips for different purposes, factors influencing trip attraction for different trip purposes; modelling trip attraction. Presentation of trip distribution data – OD matrix, PA matrix to depict trip distribution among zones; factors influencing trip distribution; variable formulation, modelling trip distribution; Gravity model of trip distribution; calibration of Gravity models.

UNIT III MODE CHOICE ANALYSIS 9

Mode choice for different trip purposes; Influencing factors – socioeconomic characteristics of travelers and characteristics of the different modes of transport; influence of trip purpose on mode choice; modelling mode choice of travelers - trip-end and trip-interchange modelling; Disaggregate mode-choice models; utility concept; Logit model of mode choice; model calibration; model validation.

UNIT IV ROUTE ASSIGNMENT AND TRANSPORTATION SURVEYS 9

Route assignment – description of transport network for route assignment; influencing variables and assignment algorithms; all-or-nothing assignment; multipath traffic assignment; capacity restrained traffic assignment. Transportation surveys – inventory of existing travel pattern, transport facilities and land-use and economic characteristics; definition of the study area; cordon lines; zoning; types of movements in the study area; types of planning related surveys.

UNIT V THE OTHER RELATED TOPICS 9

Transport related land-use models – Land-use estimation procedure; the Lowry model of land use; the equation system; allocation functions; zonal constraints. Urban Structure – urban activity systems; urban movement hierarchies; types of urban structure - centripetal, grid and linear types. Urban goods movement – factors influencing urban goods movement; classification of urban goods movement; principles of modeling urban goods movement.

TOTAL: 45 PERIODS

OUTCOMES:

C01 Explain transportation planning concepts, the planning morphology and distinction between urban and interurban transportation planning processes.

C02 Explain trip generation and trip distribution processes; formulate causal variables and develop trip generation and trip distribution models.

C03 Identify and analyze the factors influencing mode-choice of urban travellers, calibrate logit model of mode choice to apply for the given urban area.

C04 Develop route assignment variables and calibrate route choice models for assignment of trips distributed to the traffic zones in an urban area.

C05 Explain the conceptual analytical aspects of aspects transport related land-use models; describe the principals involved in urban structure and urban goods movement.

REFERENCES:

1. Juan de Dios Orituzar and Luis G. Willumson, "Modelling Transport', A john wiley and Sons, Inc., 4th edition 2017.
2. Norbert Oppenheim, "Urban Travel Demand Modelling" A John Wiley and Sons, Inc., 3rd Edition, 2010.
3. Thomas A. Domencich and Daniel Mc Fadden, "Urban Travel Demand A Behavioral Analysis", American Elsevier Publishing Company Inc., 5th Edition, 2019
4. Geetam Tiwari, "Urban Transport for Growing Cities", Macmillan India Ltd., 1st Edition, 2002.
5. B.G. Hutchinson, "Principles of Urban Transport Systems Planning", McGraw-Hill Book Company, 10th Reprint, 2010
6. Jason C.yu, "Transportation Engineering: Introduction to Planning, Design and Operations", Elsevier,1992.

IM4103 INFRASTRUCTURE PLANNING AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES :

- To understand and explain concepts of infrastructure, private involvement in infrastructure, challenges to successful infrastructure planning and implementation, strategies for successful infrastructure project implementation, sustainable development of infrastructure

UNIT I AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE: 9

Introduction to Infrastructure, an overview of the Power Sector in India., an Overview of the Water Supply and Sanitation Sector in India., an overview of the Road, Rail, Air and Port Transportation Sectors in India. , an overview of the Telecommunications Sector in India. ,an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an overview of Infrastructure Project Finance.

UNIT II PRIVATE INVOLVEMENT IN INFRASTRUCTURE: 9

A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of Water Supply: A Case Study, Challenges in Privatization of Power: Case Study, Privatization of Infrastructure in India: Case Study, Privatization of Road Transportation Infrastructure in India.

UNIT III CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION: 9

Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The Case study for Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.

UNIT IV STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION: 9

Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.

UNIT V SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE: 9

Information Technology and Systems for Successful Infrastructure Management, - Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 Explain the basic concepts related to Infrastructure Projects
CO2 Discuss the role of private sector in infrastructure growth.
CO3 Describe the strategies for successful Infrastructure Project implementation.
CO4 Develop Infrastructure modeling and Life Cycle Analysis Techniques.
CO5 Explain Sustainable development of Infrastructure

REFERENCES:

1. Grigg, Neil, Infrastructure engineering and management, Wiley, (1988).
2. Haas, Hudson, Zaniewski, Modern Pavement Management, Krieger, Malabar, (1994).
3. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).

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-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL :30 PERIODS

REFERENCES

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, 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.

IM4111 BIM AND PROJECT MANAGEMENT LABORATORY **L T P C**
0 0 4 2

OBJECTIVES

- To Conduct Laboratory tests on BIM and hands on practice in Project Management Package.

EXPERIMENTS:

BIM Lab

1. Introduction to BIM
2. 2D and 3D Exercises
3. Infrastructure Modelling
4. Introduction to GEOBIM exercises

Project Management Lab

5. Breaking down project components.
6. Defining custom data items.
7. Planning resources and costs.
8. Resource leveling.
9. Quantity and Cost Estimation
10. Hands on practice in MS Project and Primavera software packages.
11. Mini project

TOTAL: 60 PERIODS

SYSTEM SPECIFICATIONS

HP Desktops Computers - 18 Nos
(Intel i7 core, 4 GB RAM, 1 TB HDD and 1 GB Graphics card)

SOFTWARES

1. MS Project – 10 users (latest Version)
2. Primavera – 10 users (latest Version)
3. MS Office – Excel
4. Revit
5. AutoCAD

OUTCOMES:

CO1- Explain the importance of BIM in Infrastructure Projects
CO2- Develop 2D and 3D Exercises using BIM
CO3- Apply the concept of Modelling in Infrastructure Projects
CO4- Implement MS project in planning infrastructure projects
CO5- Practice MS Project and Primavera Software packages

REFERENCES :

1. Harris P.E., Project Management using Primavera, Eastern Harris Publications, 2nd Edition,2008.
2. M.S. Project – Microsoft Press, 1st Edition,2003
3. Harris P.E., Project Management using Primavera, Eastern Harris Publications, 2nd Edition,2008.
4. M.S. Project – Microsoft Press, 1st Edition,2003

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 Facets of Maintenance, importance of Maintenance, routine and preventive maintenance, causes of deterioration. Non-destructive Testing Techniques

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete based on Strength and Durability - Thermal properties, microstructure of concrete – packing density- Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Health and safety precautions for handling and applications of repair materials, Special mortars and concretes- Polymer Concrete and Mortar, Quick setting compounds, Grouting materials-Gas forming grouts, Sulfoalumate grouts, Polymer grouts, Acrylate and Urethane grouts, 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- self regulating anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, cathodic protection, Structural health monitoring.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jacketing, Steel jacketing, FRP jacketing, Strengthening, Beam shear strengthening, Flexural strengthening

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Explain the importance of maintenance assessment of distressed structures
CO2 Apply the knowledge on Quality assurance for concrete based on Strength and Durability
CO3 Identify various repair materials and advancements in concrete
CO4 Explain the knowledge on Concrete protection methods Structural health monitoring
CO5 Select Various strengthening and repair methods for different cases

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

IM4001 MATERIAL PROCUREMENT AND MANAGEMENT L T P C 3 0 0 3

OBJECTIVES :

- To Understand and Explain various types of Material Procurement, Management, Stores management and Quality Control

UNIT I INTRODUCTION: 9

Importance of material management and its role in construction industry scope, objectives and functions, Integrated approach to materials management, Role of materials manager.

UNIT II CLASSIFICATION AND CODIFICATION OF MATERIALS OF CONSTRUCTION: 9

ABC,FSN, VED, SOS analysis- Procedure and its use, Standardization in materials and their management, Procurement, identification of sources of procurement, vendor analysis. Vendor analysis concept of (MRKP) Material requirement planning, planning, purchase procedure, legal aspects

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UNIT III INVENTORY MANAGEMENT 9

Store Purchase Manual, Contractors Obligation. Inventory Control techniques. EOQ, Advantages and limitation of use of EOQ, Periodic ordering, order point control, safety stock, stock outs, application of AC analysis in inventory control, concept of (JIT) - Just in time management, Indices used for assessment of effectiveness of inventory management.

UNIT IV STORES MANAGEMENT: 9

Receipt and inspection, care and safety in handling, loss on storage, wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.

UNIT V QUALITY CONTROL 9

Conventional methods of quality control of Construction materials. Statistical method of quality control, Sampling techniques quality control in process. Quality Management and its economics. Project procurement processes. Use of (MMS) – Materials Management Systems in materials planning, procurement, inventory control, cost control etc. Project evaluation: Discounted Cash Flow, Real Options Theory. Project delivery methods, Competitive bidding.
Risk allocation and management. Integrated project delivery. Contract negotiation.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 Identify the need and role of material management Understand
CO2 Classify materials, identify sources of procurement, conduct vendor analysis
CO3 Exercise control for effective management of inventory
CO4 Manage stores and exercise quality control on materials
CO5 Apply MMS in planning, procurement, inventory and cost control, evaluate projects and manage risks

REFERENCES

1. "A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Fourth Edition, An American National Standard, ANSI/PMI 990001-2008"
2. Chitale A.K. and R.C. Gupta, “Material Management – Text and Cases”, Prentice Hall of India Pvt. Ltd., 2007
3. Denise Bower, “Management of Procurement”, Construction Management Series, Thomas Telford Publishing, 2003
4. Joseph Philips, PMP, Project Management and Professional (Certification Study Guides), McGraw Hill Publication, 2013
5. Jhamb L.C., “Inventory Management”, Everest Publishing house, 2005
6. Menon K.S., “Purchasing and Inventory Control”, Wheeler Publication, 1993
7. Ministry of Rural Development, GOI, “Procurement Manual”, National Rural Livelihoods Project, 2010
8. Peter Holm Andreasen, “Dynamics of Procurement Management – A Complexity Approach”, Copenhagen Business School, 2012
9. Peter Baily, David Farmer, Barry Crocker, David Jessop & David Jones, “Procurement Principles and Management”, FT Prentice Hall, 2010
10. Manual for Ministry of Roads, Transport and Highways (MoRTH), GOI, 2007, 4th Revision

CN4072 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION L T P C
3 0 0 3

OBJECTIVE:

- To study the concepts of Construction Economic and Finance such as comparing alternatives proposals, evaluating alternative investments, management of funds, and management of accounting.

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 Describe 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 Manage the finance and accounting

REFERENCES:

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

CN4074 ORGANIZATIONAL BEHAVIOUR L T P C
3 0 0 3

OBJECTIVE:

- To gain a solid understanding of human behavior in the workplace from an individual, group, and organizational perspective and frameworks and tools to effectively analyze and approach various organizational situations.

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 organization behaviour with balance of work life.

REFERENCES:

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

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.

AX4093	CONSTITUTION OF INDIA	L T P C 2 0 0 0

OBJECTIVES

Students will be able to:

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

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

UNIT IV ORGANS OF GOVERNANCE

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

UNIT V LOCAL ADMINISTRATION

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

UNIT VI ELECTION COMMISSION

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

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

SUGGESTED READING

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

AX4094	நற்றமிழ் இலக்கியம்	L T P C 2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், 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 மயிலுக்குத் 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
   ஐந்தினை 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

<u>தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்</u>

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