AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

&

VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

(Constituent Colleges of Vinayaka Mission's Research Foundation Deemed to be University)

AICTE APPROVED & NAAC Accredited

Faculty of Engineering and Technology

Department of Civil Engineering Programme:

M.E – STRUCTURAL ENGINEERING

REGULAR

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum & Syllabus (Semester I to IV)

Regulations 2021

VINAYAKA MISSIONS RESEARCH FOUNDATIONS FACULTY OF ENGINEERING AND TECHNOLOGY
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

&

VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

Department of Civil Engineering

CREDIT STRUCTURE FOR POST GRADUATE ENGINEERING PROGRAM (M.E – Structural Engineering –REGULAR) -2021

S.NO.	Category of courses	Type of courses	Break up of credits
1.	**A. Foundation courses**	Advanced Mathematical Methods	3
		Research Methodology and IPR	2
2.	**B. Program core courses**	Core Courses	32
3.	**C. Elective courses**	Program Electives	15
		Open Electives (Courses on emerging areas...)	03
4.	**D. Employability Enhancement Courses and courses for presentation of Technical skills related to the specialization**	Project Work Phase I	06
		Project Work Phase II	12
		Internship	01
		Technical Seminar	01
5.	**E. Audit courses**	**Any two courses on:** 1. English for Research Paper Writing 2. Value Education 3. Constitution of India 4. Pedagogy Studies 5. Personality Development Through Life Enlighten Skills	Zero credit
Total credits to be earned for the award of M.E /M.Tech degree			75

S. No	Category of courses	Type of courses	Suggested breakup of credits	Course Title
1.	A. Foundation courses	Mathematics/ Applied Mathematics	3	Advanced Mathematical Methods
		Research Methodology and IPR	2	Research Methodology and IPR
2.	B. Programme Core Courses	Core Courses	32	1. Matrix Computer Method Of Structural Analysis 2. Theory Of Elasticity And plasticity 3. Structural Dynamics And earthquake Engineering 4. Advanced Steel structures 5. Advanced Concrete structures 6. Finite Element Analysis In Structural Engineering 7. Advanced Design Of Foundation Structures 8. Construction engineering And techniques laboratory 9. Structural Design Studio
3.	C. Elective courses	Program Electives	15	1. Maintenance, Repair And Rehabilitation of Structures 2. Mechanics of Fibre Reinforced Polymer Composite Materials 3. Design of Steel Concrete Composite Structures 4. Design of Masonry Structures 5. Design of Industrial Structures 6. Optimization of Structures 7. Design of High Rise Structures 8. Design of Offshore Structures 9. Performance of Structures With Soil Structure Interaction 10. Design of Bridge Structures 11. Design of Shell And Spatial structures 12. Structural Stability 13. Non-Linear Analysis of Structures 14. Wind And Cyclone Effect On Structures 15. Prefabricated Structures 16. Advanced Concrete Technology 17. Advanced Prestressed Concrete Structures 18. Reliability Analysis of Structures 19. Design of Formwork
		Open electives (Courses on emerging areas..)	03	1.Management Information System 2.Waste to Energy 3. Biomedical Product Design and Development 4.Advanced Cyber Security 5. Bio Mems 6. Solar and Energy Storage Systems 7.Operations Research 8. Metal Additive Manufacturing

4.	D. Employability Enhancement Courses and courses for presentation of Technical skills related to the specialization	Project work Phase-I	6	
		Project work Phase-II	12	
		Internship	1	
		Technical Seminar	1	
5.	E. Audit Courses	Any two courses on: 1. English for Research Paper Writing 2. Value Education 3. Constitution of India 4. Pedagogy Studies 5. Personality Development Through Life Enlighten Skills	Zero Credit	

CREDIT STRUCTURE FOR POST GRADUATE ENGINEERING PROGRAM (M.E- STRUCTURAL ENGINEERING – REGULAR) -2022

FOUNDATION COURSES (FC)- Credits (5)									
S.No.	**COURSE CODE**	**COURSE TITLE**	**DEPT. OFFERING THE COURSE**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		Advanced Mathematical Methods	Mathematics	FC-BS	3	0	0	**3**	NIL
2.		Research Methodology and IPR	Civil	FC-HS	2	0	0	**2**	NIL
TOTAL					**5**	**0**	**0**	**5**	

PROGRAM CORE COURSES (PCC)- Credits (32)									
S. No.	**COURSE CODE**	**COURSE TITLE**	**DEPT. OFFERING THE COURSE**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		MATRIX COMPUTER METHOD OF STRUCTURAL ANALYSIS	CIVIL	CC	3	1	0	**4**	NIL
2.		THEORY OF ELASTICITY ANDPLASTICITY	CIVIL	CC	3	1	0	**4**	NIL
3.		STRUCTURAL DYNAMICS ANDEARTHQUAKE ENGINEERING	CIVIL	CC	3	1	0	**4**	NIL
4.		ADVANCED STEELSTRUCTURES	CIVIL	CC	3	1	0	**4**	NIL
5.		ADVANCED REINFORCED CONCRETESTRUCTURES	CIVIL	CC	3	1	0	**4**	NIL

6.		FINITE ELEMENT ANALYSIS INAND COMPUTER APPLICATION	CIVIL	CC	3	0	2	**4**	NIL
7.		ADVANCED DESIGN OF FOUNDATION STRUCTURES	CIVIL	CC	3	1	0	**4**	NIL
8.		CONSTRUCTIONENGINEERING ANDTECHNIQUESLABORATORY	CIVIL	CC	0	0	4	**2**	NIL
9.		STRUCTURAL DESIGN STUDIO	CIVIL	CC	0	0	4	**2**	NIL
TOTAL					**21**	**6**	**10**	**32**	

C. ELECTIVE COURSES (EC) - PROGRAM ELECTIVES- Credits (15)									
S.No.	**COURSE CODE**	**COURSE TITLE**	**DEPT. OFFERING THE COURSE**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		NON-LINEAR ANALYSIS OF STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
2.		WIND AND CYCLONE EFFECT ON STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
3.		PREFABRICATED STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
4.		ADVANCED CONCRETE TECHNOLOGY	CIVIL	EC-PS	3	0	0	**3**	NIL
5.		ADVANCED PRESTRESSED CONCRETESTRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL

6.		RELIABILITY ANALYSIS OF STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
7.		DESIGN OF FORMWORK	CIVIL	EC-PS	3	0	0	**3**	NIL
8.		MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
9.		MECHANICS OF FIBER REINFORCED POLYMER COMPOSITE MATERIALS	CIVIL	EC-PS	3	0	0	**3**	NIL
10.		DESIGN OF STEEL CONCRETECOMPOSITE STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
11.		DESIGN OF MASONRY STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
12.		DESIGN OF INDUSTRIAL STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
13.		OPTIMIZATION OF STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
14.		DESIGN OF HIGH RISE STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
15.		DESIGN OF OFFSHORE STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
16.		PERFORMANCE OF STRUCTURES WITHSOIL STRUCTURE INTERACTION	CIVIL	EC-PS	3	0	0	**3**	NIL
17.		DESIGN OF BRIDGE STRUCTURES	CIVIL	EC-PS	3	0	0	**3**	NIL
18.		DESIGN OF SHELL AND	CIVIL	EC-PS	3	0	0	**3**	NIL

		SPATIALSTRUCTURES							
19.		STRUCTURAL STABILITY	CIVIL	EC-PS	3	0	0	**3**	NIL

C. ELECTIVE COURSES (EC) - Open electives (Courses on emerging areas..) – Credits 03									
S.No	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		METAL ADDITIVE MANUFACTURING	MECH	OE-EA	3	0	0	3	NIL
2.		WASTE TO ENERGY	BTE	OE-EA	3	0	0	3	NIL
3.		BIOMEDICAL PRODUCT DESIGN AND DEVELOPMENT	BME	OE-EA	3	0	0	3	NIL
4.		ADVANCED CYBER SECURITY	CSE	OE-EA	3	0	0	3	NIL
5.		BIO MEMS	ECE	OE-EA	3	0	0	3	NIL
6.		SOLAR AND ENERGY STORAGE SYSTEMS	EEE	OE-EA	3	0	0	3	NIL

C. EMPLOYABILITY ENHANCEMENT COURSES AND COURSES FOR PRESENTATION OF TECHNICAL SKILLS RELATED TO THE SPECIALIZATION- Credits (21)

S.No.	**COURSE CODE**	**COURSE TITLE**	**DEPT. OFFERING THE COURSE**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		PROJECT WORK PHASE I	CIVIL	EE-P	0	0	12	**6**	NIL
2.		PROJECT WORK PHASE II	CIVIL	EE-P	0	0	24	**12**	NIL
3.		INTERNSHIP	CIVIL	EE-I	3 weeks Training			**1**	NIL
4.		TECHNICAL SEMINAR	CIVIL	EE-S	0	0	2	**1**	NIL
TOTAL					**0**	**0**	**40**	**20**	

D. MANDATORY COURSES/AUDIT COURSES

Any two courses on:

S.No.	COURSE CODE	COURSE TITLE	DEPT. OFFERING THE COURSE	CATEGORY	L	T	P	C	PREREQUISITE
1.		ENGLISH FOR RESEARCH PAPER WRITING	CIVIL	AC	2	0	2	**0**	NIL
2.		VALUE EDUCATION	CIVIL	AC	2	0	2	**0**	NIL
3.		INDIAN CONSTITUTION	CIVIL	AC	2	0	2	**0**	NIL
4.		PEDAGOGY STUDIES	CIVIL	AC	2	0	2	**0**	NIL
5.		PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTEN SKILLS	CIVIL	AC	2	0	2	**0**	NIL
TOTAL					**0**	**0**	**10**	**0**	

IMPLEMENTATION PLAN PROGRAMME STRUCTURE

SEMESTER –I

S.No.	COURSE CODE	COURSE TITLE	DEPT. OFFERING THE COURSE	CATEGORY	L	T	P	C
	THEORY							
1.		ADVANCED MATHEMATICAL METHODS	MATHEMATICS	FC-BS	3	0	0	**3**
2.		MATRIX COMPUTER METHOD OF STRUCTURAL ANALYSIS	CIVIL	CC	3	1	0	**4**
3.		THEORY OF ELASTICITY ANDPLASTICITY	CIVIL	CC	3	1	0	**4**
4.		STRUCTURAL DYNAMICS ANDEARTHQUAKE ENGINEERING	CIVIL	CC	3	1	0	**4**
5.		ADVANCED CONCRETESTRUCTURES	CIVIL	CC	3	1	0	**4**
6.		EC - Program Electives-I	CIVIL	EC-PS	3	0	0	**3**
	PRACTICAL							
7..		CONSTRUCTIONENGINEERING ANDTECHNIQUESLABORATORY	CIVIL	CC	0	0	4	**2**
TOTAL					**18**	**4**	**4**	**24**

SEMESTER –II

S.No.	COURSE CODE	COURSE TITLE	DEPT. OFFERING THE COURSE	CATEGORY	L	T	P	C
1.		ADVANCED STEEL STRUCTURES	CIVIL	CC	3	1	0	**4**
2.		FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING	CIVIL	CC	3	1	0	**4**
3.		ADVANCED DESIGN OF FOUNDATION STRUCTURES	CIVIL	CC	3	1	0	**4**
4.		Program electives-II	CIVIL	EC-PS	3	0	0	**3**
5.		Program electives-III	CIVIL	EC-PS	3	0	0	**3**
6.		AUDIT COURSES-I	CIVIL	AC	2	0	0	**0**
7.		STRUCTURAL DESIGN STUDIO	CIVIL	CC	0	0	4	**2**
8.		TECHNICAL SEMINAR	CIVIL	EE-S	0	0	2	**1**
TOTAL					**17**	**3**	**6**	**21**

SEMESTER –III

S.No.	COURSE CODE	COURSE TITLE	DEPT. OFFERING THE COURSE	CATEGORY	L	T	P	C
THEORY								
1.		RESEARCH METHODOLOGY AND IPR	CIVIL	FC-HS	2	0	0	**2**
2.		EC - Program electives-IV	CIVIL	EC-PS	3	0	0	**3**
3.		EC - Program electives-V	CIVIL	EC-PS	3	0	0	**3**
4.		EC - Open electives	CIVIL	OE	3	0	0	**3**
5		AUDIT COURSES- II	CIVIL	AC	2	0	0	**0**
PRACTICAL								
6.		PROJECT WORK PHASE I	CIVIL	EE-P	0	0	12	**6**
7.		INTERNSHIP	CIVIL	PI-I	3 weeks Training			**1**
TOTAL					**13**	**0**	**14**	**18**

SEMESTER –IV

S.No.	COURSE CODE	COURSE TITLE	DEPT. OFFERING THE COURSE	CATEGORY	L	T	P	C
PRACTICAL								
1.		PROJECT WORK PHASE II	CIVIL	EE-P	0	0	24	**12**
TOTAL					**0**	**0**	**24**	**12**

TOTAL CREDITS – 75

FOUNDATION COURSES

	ADVANCED MATHEMATICAL METHODS	Category	L	T	P	Credit
		FC-BS	3	0	0	3

PREAMBLE

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving in the engineering field. The lectures provide an introduction to the calculus of variations, covering both classical and more recent topics (action functional and isoperimetric problems). It also provides the required skills to apply the statistical tools&conformal mapping to engineering problems. Tensor analysis presents physical laws in a clear and compact form.

PREREQUISITE -

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

1	To familiarize the students in the field of differential equations
2	To enable them to solve boundary value problems associated with engineering applications using transform methods
3	To expose the students to the concepts of calculus of variations
4	To introduce conformal mappings and their applications to fluid flows and heat flows.
5	To give the students a complete picture of tensor analysis

COURSE OUTCOMES

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

CO1. develop the mathematical methods of applied mathematics and mathematical physics	Apply
CO2. solve boundary value problems using integral transform methods	Apply
CO3. apply the concepts of calculus of variations in solving various boundary value problems	Apply
CO4. apply conformal mappings in fluid flows and heat flow problems	Apply
CO5. familiarize with the concepts of tensor analysis.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO2	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO3	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--

CO4	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--
CO5	S	S	M	L	--	--	--	M	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS

Laplace transform: Definitions, properties -Transform of error function, Bessel's function, DiracDelta function, Unit Step functions – Convolution theorem – Inverse Laplace Transform: Complexinversion formula – Solutions to partial differential equations: Heat equation, Wave equation

FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIALEQUATIONS

Fourier transform: Definitions, properties – Transform of elementary functions, Dirac Deltafunction– Convolution theorem – Parseval's identity – Solutions to partial differential equations:Heat equation, Wave equation, Laplace and Poison's equations.

CALCULUS OF VARIATIONS

Concept of variation and its properties – Euler's equation – Functionals dependant on first andhigher order derivatives – Functionals dependant on functions of several independent variables– Variational problems with moving boundaries -Direct methods – Ritz and Kantorovich methods.

CONFORMAL MAPPING AND APPLICATIONS

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffeltransformation – Transformation of boundaries in parametric form – Physical applications : Fluidflow and heat flow problems.

TENSOR ANALYSIS

Summation convention – Contravariant and covariant vectors – Contraction of tensors –Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation –Gradient, divergence and curl.

REFERENCES:

1. Andrew L.C. and Shivamoggi B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolts L., "Differential Equations and the Calculus of Variations", MIR Publishers, Moscow, 2003.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
4. Gupta A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
5. James G., "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, Horlow, 2016.
6. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

7. Ramanaiah ,G.T, Tensor Analysis “, S.Viswanathan Pvt. Ltd,Chennai

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.P.Sasikala	Professor	Mathematics /VMKVEC	sasikala@vmkvec.edu.in
2.	Dr.L.Tamilselvi	Professor	Mathematics /AVIT	ltamilselvi@avit.ac.in

	RESEARCH METHODOLOGY AND IPR	Category	L	T	P	Credit
		FC-HS	2	0	0	2

PREAMBLE

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To understand about formulate research problem
2	To determine the research analysis
3	To understand about research ethics
4	To understand that today's world is controlled by Computer, Information Technology,but tomorrow world will be ruled by ideas, concept, and creativity
5	To understand about IPR and filing patents in R & D.

COURSE OUTCOMES

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

CO1	Ability to formulate research problem	Understand
CO2	Ability to carry out research analysis	Understand
CO3	Ability to follow research ethics	Understand
CO4	Ability to understand that today's world is controlled by Computer, Information Technology,but tomorrow world will be ruled by ideas, concept, and creativity	Understand
CO5	Ability to understand about IPR and filing patents in R & D.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	-	-	-	-	-	-	-	-	-	-	-	-	-

CO2	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	-	-	-	-	-	-	S	-	-	-	-	-	-	-
CO4	S	-	-	-	S	-	-	-	-	-	-	-	-	-	-
CO5	S	-	-	-	-	M	-	-	-	-	-	S	-	-	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**RESEARCH PROBLEM AND SCOPE FOR SOLUTION**	**6**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II :	**FORMAT**	**6**

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III :	**PROCESS AND DEVELOPMENT**	**6**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-IV	**PATENT RIGHTS**	**6**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V :	**NEW DEVELOPMENTS IN IPR**	**6**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL : 30 PERIODS

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"Juta Publishers,1996.

Asimov, "Introduction to Design", Prentice Hall, 1962.

2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.

3. Mayall, “Industrial Design”, McGraw Hill, 1992.

4. Niebel, “Product Design”, McGraw Hill, 1974.

5. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners” 2010

S.No.	Name of the Faculty	Designation	Name of the College	Mail ID
1	Dr.Sangeetha SP	Professor / Civil	AVIT	sangeetha@avit.ac.in
2	Mr.Kathirvel C	Asso.Professor / Civil	VMKVEC	kathirvel@vmkvec.edu.in

PROGRAM CORE COURSES

	MATRIX COMPUTER METHOD OF STRUCTURAL ANALYSIS	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To introduce matrix force and displacement methods for two and three dimensional structures including programming aspects

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To introduce fundamental characteristics of elements and system by evaluation of its flexibility and stiffness matrices
2	To impart knowledge about analysis of system through direct and element approach of flexibility method
3	Analysis of structures by direct and element approach of stiffness method is to be included
4	Programming techniques for simple problems and use of standard programmes to be practiced
5	Awareness to the use of advanced techniques of matrix methods are to be created

COURSE OUTCOMES

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

CO1	introduce fundamental characteristics of elements and system by evaluation of its flexibility and stiffness matrices	Understand
CO2	Analysis of system through direct and element approach of flexibility method	Apply
CO3	Analysis of structures by direct and element approach of stiffness method is to be included	Apply
CO4	Programming techniques for simple problems and use of standard programmes to be practiced	Apply
CO5	Advanced techniques of matrix methods are to be created	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	-	-	-	-	-	-	-	-	-	S	S	-	-
CO2	S	S	-	-	-	M	L	-	-	M	-	-	S	-	-

CO3	S	S	M	M	M	-	L	M	M	M	-	M	S	H	M
CO4	S	S	M	-	M	-	-	M	-	M	-	M	M	M	M
CO5	S	M	-	-	-	M	L	-	-	-	L	-	M	-	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**FUNDAMENTAL CONCEPTS**	**12**

Force and displacement measurement - Generalised or independent measurements - constrained or dependent measurements - concept of flexibility and stiffness using systems of springs - Reciprocal relationships between stiffness and flexibility - stiffness and flexibility in constrained measurements - (rank of matrix)

UNIT-II :	**FLEXIBILITY METHOD**	**12**

Direct method applied to beams and frames - Relationship between element and system - Strain Energy in terms of flexibility coefficients - Approach to equivalent joint load concept through Betti's Law - Problems in beams, frames, trusses - including effect of temperature and support sinking.

UNIT-III :	**STIFFNESS METHOD**	**12**

Direct stiffness method to beams, frames and simple trusses - Strain energy in terms of stiffness coefficients - Relationship between element and systems - Static condensation techniques - Problems in beams, frames including secondary effects. Analysis of 3D structures - Grid and pin jointed trusses.

UNIT-IV	**PROGRAMMING**	**12**

Programming of solution techniques for simultaneous equation solution - Matrix operation - Simple program development for element stiffness matrix - assemblage - Complete structure of a stiffness analysis program with subroutines - Use of GTSTRUDL / STAAD / SAP to solve problems in trusses, beams and frames.

UNIT-V :	**ADVANCED TOPICS**	**12**

Sub structuring techniques - Force and displacements - band width - reduction - tridiagnolisation technique - Band solvers - Frontal - solvers - Re analysis technique - Transfer matrix method - use of symmetry and antisymmetry.

TOTAL : 60 PERIODS

REFERENCES:

1. Jack. C, McCormac, " *Structural Analysis: Using Classical and Matrix Methods*", John Wiley, Fourth Edition, 2007.
2. Rajasekaran.S, Sankarasubramanian.G, "*Computational Structural Mechanics*",

Prentice Hall of India Pvt Ltd, New Delhi - 110 001, First Edition, 2001.
3. William McGuire, Richard. H, Gallagher and Ronald. D, Ziemian *"Matrix Structural Analysis, With MASTAN2"*, John Wiley, Second Edition, 2000 .
4. Beaufit F.W et al. *"Computer Methods of Structural Analysis"*, Prentice Hall, 1970. John L.Meek, *"Matrix Structural Analysis"*, Mc Graw Hill Book Company, 1971.
5. Bathe K.J, and Wilson. E.L, *"Numerical Methods in Finite Element Analysis"*, Prentice Hall, Engle Wood Cliffs, New Jersey, USA, 1976.
6. Rubinstien. M.F, *"Matrix Computer Analysis of Structures"*, Prentice Hall, 1966.

S.No.	Name of the Faculty	Designation	Name of the College	Mail ID
1.	Mr.Senthilkumar M	AP/Civil	VMKVEC	senthilkumar@vmkvec.edu.in
2.	Mrs,Abirami R	AP/Civil	AVIT	abirami.civil@avit.ac.in

	THEORY OF ELASTICITY AND PLASTICITY	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To develop the ability to use the principles of theory of elasticity in engineeringproblems and to introduce theoretical fundamentals of theory of plasticity

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To determine the fundamental equations of elasticity.
2	To understand the application of plane stress and plane strain
3	To solve torsion problems in circular and non-circular cross-sections
4	To analyze beams resting on elastic foundations
5	To solve analytically the simple boundary value.

COURSE OUTCOMES

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

CO1	Derive and write the fundamental equations of elasticity describing the linear behavior of element and develop constitutive models based on material behavior	Understand
CO2	Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems	Apply
CO3	Solve torsion problems in circular and non-circular cross-sections	Apply
CO4	Analyse beams resting on elastic foundations	Apply
CO5	Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	-	-	-	-	-	-	-	-	-	S	S	-	-
CO2	S	S	-	-	-	M	L	-	-	M	-	-	S	-	-
CO3	S	S	M	M	M	-	L	M	M	M	-	M	S	H	M

CO4	S	S	M	-	M	-	-	M	-	M	-	M	M	M	M
CO5	S	M	-	-	-	M	L	-	-	-	L	-	M	-	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**ELASTICITY**	**12**

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law-Constitutive Equations

UNIT-II :	**2D STRESS STRAIN PROBLEMS**	**12**

Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Coordinates

UNIT-III :	**TORSION OF NON-CIRCULAR SECTION**	**12**

St.Venant's approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled Openand Closed sections-Design approach to open web section subjected to torsion – FiniteDifference Method

UNIT-IV	**BEAMS ON ELASTIC FOUNDATIONS**	**12**

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soilmedium – Winkler model – Infinite beams – Semi-infinite and finite beams – Rigid and flexible –Uniform Cross Section – Point load and UDL – Solution by Finite Differences.

UNIT-V :	**PLASTICITY**	**12**

Physical Assumptions – Yield Criteria – Failure Theories –Thick Cylinder – Plastic Stress StrainRelationship - Bending and Torsion in Elasto-Plastic Materials -Strain hardening Materials

TOTAL : 60 PERIODS

REFERENCES:

7. Ansel. C. Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional technical Reference, New Jersey, 2003.
8. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth – Heinmann-UK, 2007.
9. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.
10. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
11. Timoshenko, S. and Goodier J.N."Theory of Elasticity", Third Edition, McGraw Hill Book Co., New York, 2017.

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	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To make the students understand the basics of structural dynamics and earthquakeengineering and to develop the ability to design a earthquake resistant structure

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To analysis of system/structures with single degree of freedom and can explain the method of damping the systems.
2	To dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration
3	To derive a mathematical model of continuous system and do a dynamic analysis underfree and forced vibration
4	To study the causes and effects of earthquake
5	To design masonry and RC structures to the earthquake forces.

COURSE OUTCOMES

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

CO1	Do vibration analysis of system/structures with single degree of freedom and canexplain the method of damping the systems	Understand
CO2	Do dynamic analysis of system/structures with Multi degrees of freedom under freeand forced vibration	Apply
CO3	Derive a mathematical model of continuous system and do a dynamic analysis underfree and forced vibration	Apply
CO4	Explain the causes and effect of earthquake	Apply
CO5	Design masonry and RC structures to the earthquake forces as per the recommendations of IS codes of practice	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S

CO2	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S
CO3	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S
CO4	M	S	M	M	L	M	-	-	-	-	-	S	S	S	S
CO5	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**PRINCIPLES OF VIBRATION ANALYSIS**	**12**

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOFsystems, Response of SDOF to special forms of excitation, Effect of damping, Evaluation ofdamping, Transmissibility, vibration control, Tuned mass damper.

UNIT-II :	**DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS**	**12**

Mathematical models of two degree of freedom systems and multi degree of freedom systems,free and forced vibrations of two degree and multi degree of freedom systems, normal modes ofvibration, applications. orthogonality of normal modes, free and forced vibrations of multi degree offreedom systems, Mode superposition technique, Applications.

UNIT-III :	**DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS**	**12**

Mathematical models of continuous systems, Free and forced vibration of continuous systems,Rayleigh – Ritz method – Formulation using Conservation of Energy – Formulation using VirtualWork, Applications. Damping in MDOF systems, Nonlinear MDOF systems, and step-by-stepnumerical integration algorithms.

UNIT-IV	**EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES**	**12**

Engineering Seismology Seismotectonics and Seismic Zoning of India, Earthquake Monitoringand Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation ofEarthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures -Lessons Learnt From Past Earthquakes -Evaluation of Earthquake Forces as per codal provisions- Response Spectra, Design Spectra.

UNIT-V :	**EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES**	**12**

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations – effect ofmaterial of construction on performance of structures - Philosophy and Principle of EarthquakeResistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Design ofMasonry Buildings and R.C.C. Buildings. Design consideration - Rigid Frames – Shear walls -Lateral load analysis of structures- – Capacity based Design and

detailing

TOTAL : 60 PERIODS

REFERENCES:

1. Anil K.Chopra, Dynamics of Structures, Fifth edition, Pearson Education, 2017.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.
3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers,Fifth Edition, 2006.
4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley &Sons, 2011.
5. Bruce A Bolt, "Earthquakes" W H Freeman and Company, New York, 2003.
6. Brebbia C. A., "Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
7. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", ElsevierScience & Technology, 2012
8. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures",Prentice Hall of India, 2009.
9. Paulay.T and Priestley M.J.N., "Seismic Design of Reinforced Concrete and MasonryBuildings", John Wiley and Sons, 1992.
10. Duggal S K, "Earthquake Resistant Design of Structures", Oxford University Press, 2007.

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	ADVANCED STEEL STRUCTURES	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To study the behaviour of members and connections, analysis and design of Industrial buildings and to study the design of with cold formed steel and plastic analysis ofstructures

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To design the steel members.
2	To study about types of steel connections such as welded, boltedand moment resisting connections
3	To Analyze and design the industrial structures such as trusses, portal framessubjected to seismic forces
4	To Study the effect of axial force and shear force on steel structures and analyze thecontinuous beams, frames using plastic theory
5	To determine the behavior and design of compression and flexural members

COURSE OUTCOMES

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

CO1	Design the steel members such as purlins, gable wind girders, base platessubjected to combined forces	Understand
CO2	Explain and design the different types of steel connections such as welded, boltedand moment resisting connections	Apply
CO3	Analyze and design the industrial structures such as trusses, portal framessubjected to seismic forces	Apply
CO4	Explain the effect of axial force and shear force on steel structures and analyze thecontinuous beams, frames using plastic theory	Apply
CO5	Evaluate the behavior and design of compression and flexural members	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	S	S	S	-	-	-	-	-	-	-	-	S	S	-	-
CO2	S	M	M	-	M	M	-	-	-	-	-	S	S	-	-
CO3	S	S	S	-	-	-	-	-	-	-	-	M	S	-	-
CO4	S	S	M	-	-	-	-	-	-	-	-	SM	S	-	-
CO5	S	S	S	-	-	-	-	-	-	-	-		S	-	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**DESIGN OF MEMBERS**	**12**

Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable columnand Gable wind girder – Design of simple bases, Gusseted bases and Moment Resisting BasePlates.

UNIT-II :	**DESIGN OF CONNECTIONS**	**12**

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – SeatedConnections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections–Clip angle Connections – Split beam Connections – Framed Connections.

UNIT-III :	**ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS**	**12**

Structural Configurations - Functional and Serviceability Requirements- Analysis and design ofdifferent types of trusses – Analysis and design of industrial buildings – Sway and nonswayframes – Crane Gantry Girders - Aseismic design of steel buildings.

UNIT-IV	**PLASTIC ANALYSIS OF STRUCTURES**	**12**

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement–Moment resisting connections. Design of Straight Corner Connections - Haunched Connections–Design of continuous beams.

UNIT-V :	**DESIGN OF LIGHT GAUGE STEEL STRUCTURES**	**12**

Introduction to Direct Strength Method - Behavior of Compression Elements - Effective width forload and deflection determination – Behavior of Unstiffened and Stiffened Elements – Design ofwebs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling –Design of Compression Members – Wall Studs.

TOTAL : 60 PERIODS

REFERENCES:

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.

2. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry ofSteel Publishing, 2000.
3. Subramanian.N, Design of Steel Structures, Oxford University Press, 2016.
4. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996
5. S.K. Duggal ,Limit State Design of Steel Structures, McGraw Hill Book Company, 2017

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	ADVANCED CONCRETE STRUCTURES	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To make the students be familiar with behavior of RCC beams and columns and to design special structural members with proper detailing

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about structural behavior of flexural members and columns
2	To design compression members and construct interaction diagrams
3	To design the special elements like corbels, deep beams and grid floors
4	To design flat slab and spandrel beams
5	To Predict the moment curvature behavior and design and detail concrete elementsbased on ductility

COURSE OUTCOMES

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

CO1	Explain structural behavior of flexural members and columns	Understand
CO2	Design compression members and construct interaction diagrams	Apply
CO3	Design the special elements like corbels, deep beams and grid floors	Apply
CO4	Design flat slab and spandrel beams	Apply
CO5	Predict the moment curvature behavior and design and detail concrete elementsbased on ductility	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	M	-	-	-	-	-	-	-	-	-	S	S	-
CO2	S	S	-	-	-	-	-	-	-	-	-	-	S	-	S
CO3	S	S	-	-	-	-	-	-	-	-	-	-	S	-	S

CO4	S	S	-	-	-	-	-	-	-	-	-	-	S	-	S
CO5	S	-	M	-	-	-	-	-	-	-	-	-	S	S	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**BEHAVIOUR AND DESIGN OF R.C. BEAMS**	**12**

Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure,shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

UNIT-II :	**BEHAVIOUR AND DESIGN OF R.C. COLUMNS**	**12**

Behaviour of short and long columns - behaviour of short column under axial load with uniaxial andbi-axial moments - construction of Pu - Mu interaction curves - Design of slender columns.

UNIT-III :	**DESIGN OF SPECIAL R.C. ELEMENTS**	**12**

Design of RC walls - design of corbels - strut and tie method - design of simply supported andcontinuous deep beams - analysis and design of grid floors.

UNIT-IV	**FLAT SLABS AND YIELD LINE BASED DESIGN**	**12**

Design of flat slabs according to IS method – Check for shear - Design of spandrel beams – Yieldline theory and design of slabs - virtual work method - equilibrium method.

UNIT-V :	**INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES**	**12**

Inelastic behaviour of concrete beams - Moment-curvature curves - moment redistribution -

Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design ofcast-in-situ joints in frames.

TOTAL : 60 PERIODS

REFERENCES:

1. Gambhir.M. L., “Design of Reinforced Concrete Structures”, Prentice Hall of India, 2012.
2. Purushothaman, P, “Reinforced Concrete Structural Elements: Behaviour Analysis andDesign”, Tata McGraw Hill, 1986
3. Unnikrishna Pillai and Devdas Menon “Reinforced Concrete Design’, Third Edition, TataMcGraw Hill Publishers Company Ltd., New Delhi, 2017.
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5. Sinha.S.N., Reinforced Concrete Design", Tata McGraw Hill publishing company

Ltd.2014				
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	FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To make the students understand the basics of the Finite Element Technique, and to coverthe analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To determine the finite element problem using basic mathematical principles
2	To study about the various types of elements and Select the appropriate element formodeling
3	To Analyze a frame using truss element
4	To Formulate and analyze two and three dimensional solid finite element problems
5	To Analyze a shells, thick and thin plate and explain dynamic analysis in FEM

COURSE OUTCOMES

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

CO1	Formulate a finite element problem using basic mathematical principles	Understand
CO2	Explain the various types of elements and Select the appropriate element formodeling	Apply
CO3	Analyze a frame using truss element	Apply
CO4	Formulate and analyze two and three dimensional solid finite element problems	Apply
CO5	Analyze a shells, thick and thin plate and explain dynamic analysis in FEM	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	S	S	S	S	M	L	-	-	L	-	M	M	L	M
CO2	M	S	S	M	S	M	L	-	-	L	-	M	S	L	M
CO3	S	S	S	S	S	M	L	-	-	L	-	M	M	S	M

CO4	S	S	S	M	S	M	L	-	-	L	-	M	S	S	M
CO5	M	S	S	M	S	M	L	-	-	L	-	M	M	S	M

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**12**

Boundary value problems - Concept of piecewise approximation - Variational Methods - Rayleigh Ritz method - Methods of weighted residual - Collocation, sub domain, Galerkin, least square methods - Finite Difference Method - Concept of Finite element method - Displacement model, stress model and hybrid models - principle of minimum potential energy - Principle of minimum complimentary potential energy - Hellinger - Reissner's principle - Steps in Finite Element Analysis.

UNIT-II :	**BAR AND TRIANGULAR ELEMENT PROPERTIES (2D)**	**12**

Displacement field - compatibility and convergence criteria - Bar elements - Analysis of framed structures - 2D and 3D truss and Beam elements - Analysis of plane strain / plane stress conditions - CST, LST and QST elements.

UNIT-III :	**RECTANGULAR ELEMENT PROPERTIES (2D)**	**12**

Lagrangian, serendipity and Hermitian family elements - Rectangular and quadrilateral element - degenerated elements - sub-Iso-super parametric elements - numerical integration techniques - Isoparametric elements - axisymmetric elements.

UNIT-IV	**ELEMENT PROPERTIES (3D)**	**12**

3D brick elements - eight and twenty nodded elements - plate bending elements - thin plates - Mindlin's plate theory - thick plate elements

UNIT-V :	**APPLICATION TO FIELD PROBLEM**	**12**

Application of finite elements analysis - Torsion. **PRACTICALS (30 hours)**

Introduction of structural Analysis software Programming in Excel for model analysis-Modelling using STAAD and SAP and dynamic analysis-RCC and Steel design-Finite element modeling.

TOTAL : 60 PERIODS

REFERENCES:

1. Krishnamoorthy C.S, *"Finite Elements Analysis - Theory and Programming"*, Tata McGraw Hill publishing company limited, New Delhi, 2008.
2. Zienkiewicz. O. C, Taylor. R. L, Zhu. J.Z, *"The Finite Element Method: Its Basis and Fundamentals: Its Basis and Fundamentals"*, Butterworth-Heinemann, Sixth Edition,

2005.
3. Krishnamoorthy. C. S, Rajeev. S, Arunachalam Rajaraman., *" Computer Aided Design: Software And Analytical Tools"*, U.K, 2005.
4. Rajesekaran .S, *"Finite Element Methods in Engineering Design"*, Wheeler Publishers, Allahabad, 1999.
5. Chandrapatla. R.T, and Belagundu, A.D., *"Introduction to Finite Elements in Engineering"*, Second Edition, Prentice Hall of India, 1997
6. Bathe. K.J, *"Finite Element Procedures in Engineering Analysis"*, PHI, New Delhi, 1990.

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	ADVANCED DESIGN OF FOUNDATION STRUCTURES	Category	L	T	P	Credit
		CC	3	1	0	4

PREAMBLE

To design various types of foundations to fulfill the required criteria

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To design shallow and deep foundations for various types of structures
2	To design piles and pile caps
3	To design well foundation for bridge piers and related structures
4	To gain knowledge on design and construction of machine foundation

5	To design foundations for bridges, towers and chimneys

COURSE OUTCOMES

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

CO1	Design shallow and deep foundations for various types of structures	Apply
CO2	Design piles and pile caps	Apply
CO3	Design well foundation for bridge piers and related structures	Apply
CO4	Gain knowledge on design and construction of machine foundation	Understand
CO5	Design foundations for bridges, towers and chimneys	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	S	-	-	-	-	-	-	-	-	-	S	M	S
CO2	S	M	S	-	-	-	-	-	-	-	-	-	S	M	S
CO3	S	M	S	-	-	-	-	-	-	-	-	-	S	M	S
CO4	S	M	S	-	-	-	-	-	-	-	-	-	S	M	S
CO5	S	L	S	-	-	-	-	-	-	-	-	-	S	M	S

S- Strong **M-Medium** **L-Low**

SYLLABUS

UNIT-I :	**SHALLOW FOUNDATIONS**	**12**

soil investigation - Types of foundations and their specific applications – depth of foundation –bearing capacity and settlement estimates – structural design of isolated, strip, rectangular andtrapezoidal and combined footings – strap – raft foundation.

UNIT-II :	**PILE FOUNDATIONS**	**12**

Types of Pile foundations and their applications - Load Carrying capacity - pile load test -

Settlements - Group action - pile cap - structural design of piles and pile caps - undreamed pilefoundation

UNIT-III :	**WELL FOUNDATION**	**12**

Types of well foundations - grip length - load carrying capacity - construction of wells - failure andremedies - structural design of well foundation - lateral stability.

UNIT-IV	**MACHINE FOUNDATIONS**	**12**
Types - General requirements and design criteria - General analysis of machine foundations-soilsystem - Stiffness and damping parameters - Tests for design parameters - design of foundationfor reciprocating engines, impact type machines and rotary type machines.		
UNIT-V :	**SPECIAL FOUNDATIONS**	**12**
Foundations for towers, Chimneys and Silos - design of anchors - reinforced earth retaining walls -Advantages of earth retaining walls - Behaviour and field applications of earth retaining walls		
		TOTAL : 60 PERIODS

REFERENCES:

1. Tomlinson, M.J. and Boorman. R., Foundation Design and Construction, ELBS Longman,Seventh Edition, 2001.
2. Nayak, N.V., Foundation Design manual for Practicing Engineers, Dhanpat Rai and Sons,2012.
3. Brain J. Bell and M.J. Smith, Reinforced Concrete Foundations, George Godwin Ltd., 1981.
4. Braja M. Das, Principles of Foundations Engineering, Eighth Edition, Thomson Asia (P)Ltd., 2015.
5. Bowels J.E., Foundation Analysis and Design, Fifth Edition, McGraw-Hill International BookCo., 2017.

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	CONSTRUCTION ENGINEERING AND TECHNIQUES LABORATORY	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To provide a thorough knowledge of material selection through the material testing basedon specification.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To experimental study about the mix proportion using IS and ACI code provisions.
2	To prepare the self-compacting concrete and study the flow characteristics.
3	To Identify the proper portion of mineral and chemical admixture for concrete.
4	To experimental study abouttest the concrete in a non-destructive manner using rebound hammer.
5	To experimental study about the permeability characteristics of concrete

COURSE OUTCOMES

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

CO1	Do the mix proportion using IS and ACI code provisions.	Understand
CO2	Prepare the self-compacting concrete and study the flow characteristics.	Apply
CO3	Identify the proper portion of mineral and chemical admixture for concrete.	Apply
CO4	Test the concrete in a non-destructive manner using rebound hammer.	Apply
CO5	Know the permeability characteristics of concrete	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	S	-	M	M	-	S	L	-	L	S	S	-	M
CO2	S	-	-	-	-	-	L	-	L	-	L	-	S	-	M
CO3	S	M	-	-	-	M	-	S	L	M	L	-	S	-	-
CO4	S	-	-	S	-	-	-	-	L	-	L	-	-	-	-

CO5	-	-	-	-	-	-	-	-	L	-	L	-	-	L	-

S- Strong	M-Medium	L-Low

SYLLABUS

LIST OF EXPERIMENTS

1	Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2	Effect of minerals and chemical admixtures in concrete at fresh and hardened state withrelevance to workability, strength and durability.
3	Flow Characteristics of Self Compacting concrete.
4	Test on Cube and Cylinder strength on concrete.
5	Permeability tests on hardened concrete.
6	NDT – Ultrasonic flaw detector
7	NDT on hardened concrete –Rebound hammer.
8	NDT on hardened concrete – UPV and Rebound hammer.
9	Ultrasonic interferometer – ultrasonic velocity in liquids

TOTAL : 30 PERIODS

REFERENCES:

1. 1. Anil K.Chopra, Dynamics of Structures, Fifth edition, Pearson Education, 2017.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.
3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers,Fifth Edition, 2006.
4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley &Sons, 2011.
5. Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2003.
6. Brebbia C. A., ”Earthquake Resistant Engineering Structures VIII”,WIT Press, 2011
7. Mohiuddin Ali Khan “Earthquake-Resistant Structures: Design, Build and Retrofit”, ElsevierScience & Technology, 2012
8. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”,Prentice Hall of India, 2009.
9. Paulay.T and Priestley M.J.N., “Seismic Design of Reinforced Concrete and MasonryBuildings”, John Wiley and Sons, 1992.
10. Duggal S K, “Earthquake Resistant Design of Structures”, Oxford University Press, 2007.

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	STRUCTURAL DESIGN STUDIO	Category	L	T	P	Credit
		CC	0	0	4	2

PREAMBLE

To design a structure using modern software tools available like ETABS, STAAD, STRAP etc. and present it in the form of complete detail drawing

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To Plan a layout of a structure
2	To determine the loads using IS codes and various computational tools
3	To Analyze the structure for various loads and load combination according to therelevant IS codes
4	To design and detail structures using computer software/tools and check thecorrectness using manual approximate methods
5	To prepare the complete structural drawings using computer software

COURSE OUTCOMES

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

CO1	Plan a layout of a structure	Understand
CO2	Calculate loads using IS codes and various computational tools	Apply
CO3	Analyze the structure for various loads and load combination according to therelevant IS codes	Apply
CO4	Design and detail structures using computer software/tools and check thecorrectness using manual approximate methods	Apply
CO5	Prepare the complete structural drawings using computer software	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	S	S	S	S	S	S	M	S	M	L	S	S	S	S
CO2	M	M	M	S	S	S	S	M	M	M	L	M	S	S	S
CO3	S	S	M	S	S	S	S	M	M	M	L	M	S	M	S

CO4	S	S	S	S	S	S	S	M	S	M	L	S	S	S	S
CO5	M	M	M	M	S	S	S	M	M	M	L	S	S	M	S
S- Strong				**M-Medium**						**L-Low**					

SYLLABUS

Students have to work individually with standard codes, computational tools and softwarepackages for analyzing, designing and detailing a structure. A detailed report on the work doneshall be submitted by individual student in the form of a report and presentation.

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ELECTIVE COURSE

Program Electives

	NON-LINEAR ANALYSIS OF STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the concept of nonlinear behaviour and analysis of elements and simple structures.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To analyze bar system considering material and geometric nonlinearity.
2	To study about inelastic analysis flexural members.
3	To study about vibration analysis of flexural members.
4	To study about elastic and inelastic analysis of Plates.
5	To determine about nonlinear and instability analysis of elastically supported beams.

COURSE OUTCOMES

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

CO1	Analyze bar system considering material and geometric nonlinearity	Understand
CO2	Perform inelastic analysis flexural members	Apply
CO3	Perform vibration analysis of flexural members	Apply
CO4	Perform elastic and inelastic analysis of Plates	Apply
CO5	Perform nonlinear and instability analysis of elastically supported beams	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	S	S	S	L	L	L	L	L	S	S	S	S
CO2	S	S	S	S	S	S	L	L	L	L	L	S	S	S	S
CO3	S	S	S	S	S	S	L	L	L	L	L	S	S	S	S
CO4	S	S	S	S	S	S	L	L	L	L	L	S	S	S	S
CO5	S	S	S	S	S	S	L	L	L	L	L	S	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION TO NONLINEAR ANALYSIS**	**9**

Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness.

UNIT-II :	**INELASTIC ANALYSIS OF FLEXURAL MEMBERS**	**9**

Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of bars of uniform and variable stiffness members with and without axial Restraints

UNIT-III :	**VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS**	**9**

Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading

UNIT-IV	**ELASTIC AND INELASTIC ANALYSIS OF PLATES**	**9**

Elastic and inelastic analysis of uniform and variable thickness plates.

UNIT-V :	**NONLINEAR VIBRATION AND INSTABILITY**	**9**

Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL : 45 PERIODS

REFERENCES:

1. Fertis, D.G, Non-linear Mechanics, CRC Press, 1999.
2. Reddy. J.N, Non-linear Finite Element Analysis, Oxford University Press, 2008.
3. Sathyamoorthy. M, Nonlinear Analysis of Structures, CRC Press, 2010.

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	WIND AND CYCLONE EFFECTS ON STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the concept of wind and cyclone effects for the analysis and design of structures

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about the characteristics of wind
2	To determine the intensity of wind on structures
3	To design some special structures subjected to wind loading
4	Design of structures for cyclone
5	Model and analyze a structure in a wind tunnel

COURSE OUTCOMES

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

CO1	Explain the characteristics of wind	Understand
CO2	Evaluate the intensity of wind on structures	Apply
CO3	Design some special structures subjected to wind loading	Apply
CO4	Design of structures for cyclone	Apply
CO5	Model and analyze a structure in a wind tunnel	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	M	L	L	L	L	L	L	L	S	S	M	L
CO2	S	S	M	S	M	L	L	L	L	L	L	M	S	S	S
CO3	S	S	S	S	M	L	L	L	L	L	L	M	S	S	S
CO4	S	S	S	S	M	L	L	L	L	L	L	M	S	S	S
CO5	S	S	S	S	M	L	L	L	L	L	L	H	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

Introduction, Types of wind – Characteristics of wind – Method of Measurement of wind velocity,variation of wind speed with height, shape factor, aspect ratio, drag and lift effects – Dynamicnature of wind –Pressure and suctions - Spectral studies, Gust factor.

UNIT-II :	**EFFECT OF WIND ON STRUCTURES**	**9**

Classification of structures – Rigid and Flexible – Effect of wind on structures –Vortex shedding,translational vibration of structures - Static and dynamic effects on Tall buildings - Chimneys.

UNIT-III :	**DESIGN OF SPECIAL STRUCTURES**	**9**

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – design of –Industrial sheds – Tall Buildings – Chimneys – Transmission towers and steel monopoles

UNIT-IV	**CYCLONE EFFECTS**	**9**

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone oncladdings – design of cladding – use of code provisions in cladding design – Analytical procedureand modeling of cladding.

UNIT-V :	**WIND TUNNEL STUDIES**	**9**

Wind Tunnel Studies, Types of wind tunnels, Types of wind tunnel models – Modellingrequirements - Aero dynamic and Aero-elastic models, Prediction of acceleration – Loadcombination factors – Wind tunnel data analysis – Calculation of Period and damping value forwind design

TOTAL : 45 PERIODS

REFERENCES:

1. Cook.N.J., “The Designer's Guide to Wind Loading of Building Structures”, Butterworths,1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, “Wind Effects on Civil EngineeringStructures”, Elsevier Publications, 1984
3. Lawson T.V., “Wind Effects on Building Vol. I and II”, Applied Science Publishers,London,1980.
4. Peter Sachs, “Wind Forces in Engineering”, Pergamon Press, New York, 1978.

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	PREFABRICATED STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To Study the design principles, analysis and design of elements**.**

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study design principles involved in prefabrication
2	To study about types of connection
3	To design for stripping forces during manufacture
4	To determine the forces in shear walls
5	To Identify the different roof trusses used in industrial buildings

COURSE OUTCOMES

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

CO1	Explain the design principles involved in prefabrication	Understand
CO2	Detail the different types of connection	Apply
CO3	Design for stripping forces during manufacture	Apply
CO4	Determine the forces in shear walls	Apply
CO5	Identify the different roof trusses used in industrial buildings	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	-	M	-	-	-	-	-	-	-	M	M	-	-	-
CO2	M	S	S	-	M	-	-	-	-	-	M	M	-	-	-
CO3	S	S	S	-	S	-	-	L	-	S	M	M	S	S	S
CO4	S	S	S	-	S	-	M	M	-	-	M	M	S	S	S
CO5	S	-	S	-	M	-	M	M	-	-	M	M	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**DESIGN PRINCIPLES**	**9**

General Civil Engineering requirements, specific requirements for planning and layout ofprefabrication plant. IS Code specifications. Modular co-ordination, standardization, Disuniting ofPrefabricates, production, transportation, erection, stages of loading and code provisions, safetyfactors, material properties, Deflection control

UNIT-II :	**REINFORCED CONCRETE**	**9**

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two wayprefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam tocolumn and column to column.

UNIT-III :	**FLOORS, STAIRS AND ROOFS**	**9**

Types of floor slabs, analysis and design example of cored and panel types and two-way systems,Design analysis for product manufacture, handling and erection, staircase slab, types of roof slabsand insulation requirements, Description of joints, their behaviour and reinforcement requirements,Deflection control for short term and long term loads, Ultimate strength calculations in shear andflexure.

UNIT-IV	**WALLS**	**9**

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load

transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, DesignCurves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwichwall panels, Lateral load resistance, Location and types of shear walls, approximate design ofshear walls.

UNIT-V :	**INDUSTRIAL BUILDINGS AND SHELL ROOFS**	**9**

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, RoofPanels, corbels and columns, wind bracing. Cylindrical, Folded plate and paraboloid shells,Erection and jointing of components in industrial buildings

TOTAL : 45 PERIODS

REFERENCES:

1. Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
2. Koncz.T. Manual of Precast Concrete Construction, Vol.I II and III & IV Bauverlag, GMBH,1971.
3. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, Akademiai Kiado,Budapest, 2007.
4. Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, 1988.

5. Structural Design manual, Precast concrete connection details, Society for studies in theuse of Precast concrete, Netherland Betor Verlag, 2009.

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	ADVANCED CONCRETE TECHNOLOGY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

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

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To gain knowledge on various materials needed for concrete manufacture
2	To study about the rules to do mix designs for concrete by various methods
3	To study about the methods of manufacturing of concrete.
4	To study about various special concrete
5	To determine the various tests on fresh and hardened concrete

COURSE OUTCOMES

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

CO1	Develop knowledge on various materials needed for concrete manufacture	Understand
CO2	Apply the rules to do mix designs for concrete by various methods	Apply
CO3	Develop the methods of manufacturing of concrete.	Apply
CO4	Explain about various special concrete	Apply
CO5	Explain various tests on fresh and hardened concrete	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	M	-	-	-	-	-	-	-	M	-	-	-
CO2	-	S	S	-	-	M	-	-	-	-	L	-	-	-	-
CO3	M	-	-	-	S	S	-	S	M	S	-	S	L	-	-
CO4	M	-	-	-	S	-	-	S	-	S	-	M	-	L	-

CO5	M	-	-	S	M	M	L	-	-	M	-	M	-	-	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**CONCRETE MAKING MATERIALS**	**9**

Aggregates classification IS Specifications, Properties, Grading, Methods of combiningaggregates, specified gradings, Testing of aggregates. Cement, Grade of cement, Chemicalcomposition, Testing of concrete, Hydration of cement, Structure of hydrated cement, specialcements. Water Chemical admixtures, Mineral admixture.

UNIT-II :	**MIX DESIGN**	**9**

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOEMethod – 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, Extremeweather 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 mixedconcrete.

UNIT-V :	**TESTS ON CONCRETE**	**9**

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

TOTAL : 45 PERIODS

REFERENCES:

1. Gambhir.M.L. Concrete Technology, Fifth Edition, McGraw Hill Education, 2017.
2. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Shetty M.S., Concrete Technology, Revised Edition, S.Chand and Company Ltd. Delhi,2006.
5. Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015.

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	ADVANCED PRESTRESSED CONCRTE	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

Principle of prestressing, analysis and design of prestressed concrete structures**.**

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about various methods of prestressing
2	To design the beams for shear, bond and torsion
3	To design the continuous beams
4	To design the water tank, piles and masts
5	To Analyze and design the composite beams

COURSE OUTCOMES

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

CO1	Identify the various methods of prestressing	Understand
CO2	Design the beams for shear, bond and torsion	Apply
CO3	Design the continuous beams	Apply
CO4	Design the water tank, piles and masts	Apply
CO5	Analyze and design the composite beams	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	L	-	-	-	-	-	-	-	-	L	M	-	M
CO2	-	S	M	-	-	-	-	-	-	-	-	M	S	M	S
CO3	-	S	S	-	L	-	-	-	-	-	-	M	S	M	S
CO4	-	S	S	-	M	-	-	L	-	-	-	M	S	M	S
CO5	-	S	S	M	L	-	-	L	-	-	-	M	S	M	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**PRINCIPLES OF PRESTRESSING**	**9**

Basic concepts of Prestressing - Types and systems of prestressing - Need for High Strengthmaterials, Analysis methods, losses of prestress – Short and Long term deflections – Cablelayouts.

UNIT-II :	**DESIGN OF FLEXURAL MEMBERS**	**9**

Behaviour of flexural members, determination of ultimate flexural strength – Various Codalprovisions - Design of flexural members, Design for shear, bond and torsion. Transfer of prestress– Box girders.

UNIT-III :	**DESIGN OF CONTINUOUS AND CANTILEVER BEAMS**	**9**

Analysis and design of continuous beams - Methods of achieving continuity - concept of lineartransformations, concordant cable profile and gap cables – Analysis and design of cantileverbeams.

UNIT-IV	**DESIGN OF TENSION AND COMPRESSION MEMBERS**	**9**

Design of tension members - application in the design of prestressed pipes and prestressedconcrete cylindrical water tanks - Design of compression members with and without flexure – itsapplication in the design piles, flag masts and similar structures.

UNIT-V :	**DESIGN OF COMPOSITE MEMBERS**	**9**

Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing- its advantages and applications.

TOTAL : 45 PERIODS

REFERENCES:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York,2004.
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 6th Edition, 2018.
3. Lin.T.Y.andBurns.H “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, 3rd Edition, 2010.
4. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2014.
5. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 1998.

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	RELIABILITY ANALYSIS OF STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To develop knowledge to solve structural analysis problems using reliability concepts.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To gain the Knowledge of design and development of problem solving skills.
2	To understand the principles of reliability.
3	To design and develop analytical skills.
4	To study about the Probability distributions
5	To understands the concept of System reliability.

COURSE OUTCOMES

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

CO1	Achieve Knowledge of design and development of problem solving skills.	Understand
CO2	Understand the principles of reliability.	Understand
CO3	Design and develop analytical skills.	Apply
CO4	Summarize the Probability distributions	Understand
CO5	Understands the concept of System reliability.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	M	M	L	L	L	L	L	L	M	S	S	M
CO2	S	S	S	M	M	L	L	L	L	L	L	M	S	S	M
CO3	S	S	S	M	M	L	L	L	L	L	L	M	S	S	M
CO4	M	S	S	M	M	L	L	L	L	L	L	M	S	S	M
CO5	S	S	S	M	M	L	L	L	L	L	L	M	S	S	M

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**DATA ANALYSIS**	**9**

Graphical representation Histogram, frequency polygon, Measures of central tendency – groupedand ungrouped data, measures of dispersion, and measures of asymmetry. Curve fitting andCorrelation: Fitting a straight line, curve of the form y = abx, and parabola, Coefficient of correlation

UNIT-II :	**PROBABILITY CONCEPTS**	**9**

Random events-Sample space and events, Venn diagram and event space, Measures ofprobability-interpretation, probability axioms, addition rule, multiplication rule, conditionalprobability, probability tree diagram, statistical independence, total probability theorem and Baye'stheorem

UNIT-III :	**RANDOM VARIABLES**	**9**

Probability mass function, probability density function, Mathematical expectation, Chebyshev'stheorem. Probability distributions: Discrete distributions- Binomial and poison distributions,Continuous distributions, Normal, Log normal distributions

UNIT-IV	**RELIABILITY ANALYSIS**	**9**

Measures of reliability-factor of safety, safety margin, reliability index, performance function andlimiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point EstimateMethod (PEM), and Advanced First Order Second Moment Method (Hasofer Lind's method).

UNIT-V :	**SYSTEM RELIABILITY**	**9**

Influence of correlation coefficient, redundant and non-redundant systems series, parallel andcombined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision ofreliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample sizeand accuracy, Generation of random numbers, random numbers with standard uniformdistribution, continuous random variables, discrete random variables

TOTAL : 45 PERIODS

REFERENCES:

1. A Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, NewYork, 1993.
2. R E Melchers, Structural Reliability Analysis and Prediction, Third Edition, John Wiley &Sons Ltd, Chichester, England,2018.
3. O. Ditlevsen, H. O. Madsen, Structural Reliability Methods, Wiley, 1st Edition, 1996.
4. Srinivasan Chandrasekaran, Offshore Structural Engineering: Reliability and

RiskAssessment, CRC Press, Florida, 2016.

5. Jack R Benjamin ,C. Allin Cornell, Probability, Statistics, and Decision for Civil Engineers ,Dover Publications, Newyork, 2014.

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	DESIGN OF FORMWORK	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study and understand the detailed planning of formwork , Design of forms for variouselements such as foundation, slabs, beams, columns and walls.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To understand the formwork, accessories and material.
2	To design the form work for Beams, Slabs, columns, Walls and Foundations
3	To design the form work for Special Structures
4	To describe the working of flying formwork.
5	To study about the formwork failures through case studies

COURSE OUTCOMES

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

CO1	Select proper formwork, accessories and material.	Understand
CO2	Design the form work for Beams, Slabs, columns, Walls and Foundations	Apply
CO3	Design the form work for Special Structures	Apply
CO4	Describe the working of flying formwork.	Apply
CO5	Judge the formwork failures through case studies	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	L	S	L	L	M	-	L	L	M	-	-	M	L	L
CO2	M	S	S	M	L	M	L	-	-	M	-	L	S	S	S
CO3	M	S	S	M	L	M	L	-	-	M	-	L	S	S	S
CO4	L	-	M	M	M	M	L	-	-	M	-	L	S	S	S

CO5	M	S	M	M	M	M	L	L	L	M	-	L	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

General objectives of formwork building - Development of a Basic System - Key Areas of costreduction - Requirements and Selection of Formwork.

UNIT-II :	**FORMWORK MATERIALS AND TYPES**	**9**

Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical FormworkSupports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for PrecastConcrete,

UNIT-III :	**FORMWORK DESIGN**	**9**

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT-IV	**FORMWORK DESIGN FOR SPECIAL STRUCTURES**	**9**

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT-V :	**FORMWORK FAILURES**	**9**

Formwork Management Issues – Pre- and Post-Award. Formwork Failures: Causes and Casestudies in Formwork Failure, Formwork Issues in Multi story Building Construction.

TOTAL : 45 PERIODS

REFERENCES:

1. Formwork for Concrete Structures, R. L. Peurifoy, McGraw Hill India, 2010.
2. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
4. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute,Detroit, 1996
5. Michael P. Hurst, Construction Press, London and New York, 2003.

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	MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the damages, repair and rehabilitation of structures

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study the importance of maintenance assessment of distressed structures
2	To Apply the knowledge on Quality assurance for concrete based on Strength andDurability
3	To Identify various repair materials and advancements in concrete
4	To study the knowledge on Concrete protection methods Structural health monitoring
5	To study about Various strengthening and repair methods for different cases

COURSE OUTCOMES

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

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	-	S	-	M	-	-	-	-	L	-	M	-	-
CO2	M	M	-	S	-	M	L	-	M	S	-	-	M	-	-
CO3	-	-	S	-	S	-	-	M	M	-	-	M	-	S	M
CO4	-	-	M	-	S	-	-	S	M	S	-	M	-	S	S

CO5	M	-	S	-	M	-	-	M	-	M	-	M	-	M	M

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**MAINTENANCE AND REPAIR STRATEGIES**	**9**

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation ofstructures Facets of Maintenance, importance of Maintenance, routine and preventivemaintenance, 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 toclimate, 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 mortarsand concretes- Polymer Concrete and Mortar, Quick setting compounds, Grouting materials-Gasforming grouts, Sulfoalumate grouts, Polymer grouts, Acrylate and Urethane grouts, Bondingagents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings forConcrete and Steel, FRP sheets

UNIT-IV	**PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING**	**9**

Concrete protection methods – reinforcement protection methods- 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 ofembedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosiondamaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beamjacketing, Beam Column joint jacketing, Reinforced concrete jacketing, Steel jacketing, FRPjacketing, Strengthening, Beam shear strengthening, Flexural strengthening

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 andRehabilitation of Concrete Structures, Allied Publishers, 2004.
4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, NarosaPublishers, 2008.
5. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General worksCPWD ,Govt of India , New Delhi – 2002

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	MECHANICS OF FIBER REINFORCED POLYMERCOMPOSITE MATERIALS	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the behaviour of composite materials and to investigate the failure and fracturecharacteristics.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study various types of composites and its constituents
2	To Derive the constitutive relationship and determine the stresses and strains ina composite material
3	To Analyze a laminated plate
4	To study about failure criteria and fracture mechanics of composites
5	To design simple composite elements

COURSE OUTCOMES

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

CO1	Explain the various types of composites and its constituents	Understand
CO2	Derive the constitutive relationship and determine the stresses and strains ina composite material	Apply
CO3	Analyze a laminated plate	Apply
CO4	Explain the various failure criteria and fracture mechanics of composites	Understand
CO5	Design simple composite elements	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	L	-	-	-	-	-	L	-	M	M	L	M
CO2	S	M	M	-	-	-	-	-	-	L	-	-	S	M	M

CO3	S	S	M	-	-	-	-	-	-	L	-	-	S	M	M
CO4	M	M	M	-	-	-	-	-	-	L	-	-	S	M	S
CO5	S	S	S	-	-	-	-	-	-	S	-	M	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

Introduction to Composites, Classifying composite materials, commonly used fiber and matrixconstituents, Composite Construction, Properties of Unidirectional Long Fiber Composites andShort Fiber Composites

UNIT-II :	**STRESS STRAIN RELATIONS**	**9**

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, LinearElasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT-III :	**ANALYSIS OF LAMINATED COMPOSITES**	**9**

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates –Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminarstresses

UNIT-IV	**FAILURE AND FRACTURE OF COMPOSITES**	**9**

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics ofComposites, Sandwich Construction.

UNIT-V :	**APPLICATIONS AND DESIGN**	**9**

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design withComposites, Review, Environmental Issues

TOTAL : 45 PERIODS

REFERENCES:

1. Agarwal.B.D. Broutman.L.J. and Chandrashekara.K. "Analysis and Performance of FiberComposites", Fourth Edition, John-Wiley and Sons, 2017
2. Daniel.I.M, and Ishai.O, "Engineering Mechanics of Composite Materials", Second Edition,Oxford University Press, 2005.
3. Hyer M.W., and White S.R., "Stress Analysis of Fiber-Reinforced Composite Materials",D.Estech Publications Inc., 2009
4. Jones R.M., "Mechanics of Composite Materials", Taylor and Francis Group 1999.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universities Press,India, 2005.

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	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To develop an understanding of the behaviour and design concrete composite elementsand structures.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study composite action
2	To design composite elements
3	To design connections
4	To understand the concept of design of composite box girder bridges
5	To study and evaluate case studies

COURSE OUTCOMES

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

CO1	Explain composite action	Understand
CO2	Design composite elements	Apply
CO3	Design connections	Apply
CO4	Explain the concept of design of composite box girder bridges	Apply
CO5	Study and evaluate case studies	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	L	-	-	L	M	S	M	M	M	M	M	S
CO2	S	S	S	L	M	-	L	M	S	M	M	M	M	M	S
CO3	S	S	S	M	-	-	-	L	M	L	M	M	M	M	M
CO4	S	M	L	-	-	-	M	M	M	-	-	-	M	M	M
CO5	-	M	-	M	-	M	S	M	M	M	M	M	-	S	L

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

Introduction to steel - concrete composite construction – Codes – Composite action Serviceabilityand Construction issues in design.

UNIT-II :	**DESIGN OF COMPOSITE MEMBERS**	**9**

Design of composite beams, slabs, columns; beam – columns - Design of composite trusses.

UNIT-III :	**DESIGN OF CONNECTIONS**	**9**

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction

UNIT-IV	**COMPOSITE BOX GIRDER BRIDGES**	**9**

Introduction - behaviour of box girder bridges - design concepts.

UNIT-V :	**CASE STUDIES**	**9**

Case studies on steel - concrete composite construction in buildings - seismic behavior ofcomposite structures.

TOTAL : 45 PERIODS

REFERENCES:

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns andFrames for Buildings”, Vol.I, Fourth Edition, Blackwell Scientific Publications, 2018
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members,Fundamental behaviour”, Revised Edition, Pergamon press, Oxford, 2000.
3. Owens.G.W and Knowles.P, ”Steel Designers Manual”, Seventh Edition, Steel ConcreteInstitute(UK), Oxford Blackwell Scientific Publications, 2011.
4. Narayanan R, “Composite steel structures – Advances, design and construction”, Elsevier,Applied science, UK, 1987
5. Teaching resource for, “Structural Steel Design,” Volume 2 of 3, Institute for SteelDevelopment and Growth (INSDAG), 2002.

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	DESIGN OF MASONRY STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To design, detail and retrofit a masonry structure.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study the properties of a masonry unit and the various components
2	To design a masonry structure for compression
3	To design a masonry structure for lateral loads
4	To design a earthquake resistant masonry wall
5	To study the techniques for existing masonry walls

COURSE OUTCOMES

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

CO1	Explain the properties of a masonry unit and the various components	Understand
CO2	Design a masonry structure for compression	Apply
CO3	Design a masonry structure for lateral loads	Apply
CO4	Design a earthquake resistant masonry wall	Apply
CO5	Suggest retrofitting techniques for existing masonry walls	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	-	-	-	-	-	-	-	-	M	M	M	M
CO2	S	S	S	-	-	-	-	-	-	-	-	M	S	M	S
CO3	S	S	S	-	-	-	-	-	-	-	-	M	S	M	S
CO4	S	S	S	-	S	-	-	-	-	-	-	M	S	S	S
CO5	S	S	S	S	-	-	-	-	-	-	-	M	M	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

Introduction - Masonry construction - National and International perspective – Historicaldevelopment, Modern masonry, Material Properties - Masonry units: clay and concrete blocks,Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

UNIT-II :	**DESIGN OF COMPRESSION MEMBER**	**9**

Principles of masonry design, Masonry standards: IS 1905 and others.- Masonry in Compression -Prism strength, Eccentric loading -Kern distance. Structural Wall, Columns and Plasters, RetainingWall, Pier and Foundation – Prestressed masonry

UNIT-III :	**DESIGN OF MASONRY UNDER LATERAL LOADS**	**9**

Masonry under Lateral loads - In-plane and out-of-plane loads, Ductility of Reinforced MasonryMembers Analysis of perforated shear walls, Lateral force distribution -flexible andrigiddiaphragms. Behaviour of Masonry - Shear and flexure - Combined bending and axial loads -Reinforced and unreinforced masonry -- Infill masonry

UNIT-IV	**ASEISMIC DESIGN OF MASONRY STRUCTURES**	**9**

Structural design of Masonry - Consideration of seismic loads - Cyclic loading and ductility ofshear walls for seismic design -Code provisions- Working and Ultimate strength design In-planeand out-of-plane design criteria for load-bearing and infills, connecting elements and ties. ModelingTechniques, Static Push Over Analysis and use of Capacity Design Spectra – use of Software.

UNIT-V :	**RETROFITTING OF MASONRY**	**9**

Seismic evaluation and Retrofit of Masonry - In-situ and non-destructive tests for masonry - properties - Repair and strengthening of techniques.

TOTAL : 45 PERIODS

REFERENCES:

1. Drysdale, R. G. Hamid, A. H. and Baker, L. R, “Masonry Structures: Behaviour &Design”,Prentice Hall Hendry, 1994.
2. A.W. Hendry, B.P. Sinha and Davis, S. R, “Design of Masonry Structures”, E & FN Spon,UK, 1997.
3. R.S. Schneider and W.L. Dickey, “Reinforced Masonry Design”, Prentice Hall, 3rd edition,1994.
4. Paulay, T. and Priestley, M. J. N., “Seismic Design of Reinforced Concrete and MasonryBuildings”, John Wiley, 1992.

5. A.W. Hendry, “Structural Masonry”, 2nd Edition, Palgrave McMillan Press, 1998.				
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	DESIGN OF INDUSTRIAL STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To disseminate knowledge about planning and design of RCC and STEEL Industrialstructures**.**

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study the concept of planning & functional requirement of industrial standards.
2	To Analyse and design of Steel Gantry girders & Crane girders and RCC design of corbels, nibs and staircase.
3	To Analyse & design of cooling towers, bunker, silos and pipe supporting structures.
4	To Analyse and design of Steel transmission line towers and chimneys.
5	To design foundations for cooling tower, chimneys and turbo generator.

COURSE OUTCOMES

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

CO1	Develop the concept of planning & functional requirement of industrial standards.	Understand
CO2	Analyse and design of Steel Gantry girders & Crane girders and RCC design ofcorbels, nibs and staircase.	Apply
CO3	Analyse & design of cooling towers, bunker, silos and pipe supporting structures.	Apply
CO4	Analyse and design of Steel transmission line towers and chimneys.	Apply
CO5	Design foundations for cooling tower, chimneys and turbo generator.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	M	-	-	M	S	M	-	-	M	S	-	S
CO2	-	S	S	M	L	M	L	S	-	M	-	M	S	S	S
CO3	M	S	S	M	L	M	L	S	-	M	-	M	S	S	S

CO4	-	S	S	M	L	M	L	S	-	M	-	M	S	S	S
CO5	-	M	S	M	L	M	L	S	-	M	-	M	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**PLANNING AND FUNCTIONAL REQUIREMENTS**	**9**

Classification of Industries and Industrial structures - planning for Layout Requirements regardingLighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines ofFactories Act.

UNIT-II :	**INDUSTRIAL BUILDINGS**	**9**

Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase.

UNIT-III :	**POWER PLANT STRUCTURES**	**9**

Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos – Pipesupporting structures

UNIT-IV	**TRANSMISSION LINE STRUCTURES AND CHIMNEYS**	**9**

Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations,Methods of tower testing – Design of self supporting and guyed chimney, Design of Chimneybases.

UNIT-V :	**FOUNDATION**	**9**

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design ofTurbo Generator Foundation.

TOTAL : 45 PERIODS

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings:A Design Manual, Birkhauser Publishers, 2004.
2. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
3. Swami saran, Analysis & Design of substructures, Limit state Design second Edition.
4. D, N. Subramaniyan, Design of Steel Structures 2016
5. N. Krishna Raju, Advanced Reinforced concrete Design, 3rd edition 2016,

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	OPTIMIZATION OF STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the optimization methodologies applied to structural engineering.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To studyabout engineering fundamentals to formulate and solve theengineering problems by classical optimization techniques.
2	To Identify, formulate and solve engineering problems by linear and non-linearprogramming.
3	To Analyse the problem and reducing G.P.P to a set of simultaneous equations.
4	To Apply the Engineering knowledge to understand the concept of dynamicprogramming
5	To design various structural elements with minimum weight.

COURSE OUTCOMES

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

CO1	Apply the knowledge of engineering fundamentals to formulate and solve theengineering problems by classical optimization techniques.	Apply
CO2	Identify, formulate and solve engineering problems by linear and non-linearprogramming.	Understand
CO3	Analyse the problem and reducing G.P.P to a set of simultaneous equations.	Apply
CO4	Apply the Engineering knowledge to understand the concept of dynamicprogramming	Apply
CO5	Design various structural elements with minimum weight.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	-	-	-	-	M	-	-	-	-	-	-	-	-
CO2	-	M	-	-	M	-	-	-	-	-	-	-	M	M	M
CO3	-	S	-	-	M	-	-	-	-	-	-	-	M	M	M

CO4	S	M	-	-	M	-	-	-	-	-	-	-	M	M	M
CO5	-	M	L	M	-	L	M	M	M	M	M	M	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES**	**9**

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear Side,Non-negativity, Behaviour and other constraints - Design space - Feasible and infeasible- Convexand Concave - Active constraint - Local and global optima. Differential calculus – Optimalitycriteria - Single variable optimization - Multivariable optimization with no constraints- - (LagrangeMultiplier method) - with inequality constraints (Khun - Tucker Criteria).

UNIT-II :	**LINEAR AND NON-LINEAR PROGRAMMING**	**9**

LINEAR PROGRAMMING:

Formulation of problems -Graphical solution – Analyticalmethods- Standard form - Slack, surplus and artificial variables - Canonical form – Basic feasiblesolution - simplex method - Two phase method - Penalty method- Duality theory -Primal – Dualalgorithm, Dual Simplex method.

NON LINEAR PROGRAMMING:

One Dimensional minimizationmethods: Unidimensional - Unimodal function – Exhaustive and unrestricted search -Dichotomous search - Fibonacci Method – Golden section method Interpolation methods.Unconstrained optimization Techniques.

UNIT-III :	**GEOMETRIC PROGRAMMING**	**9**

Polynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems withone degree of difficulty.

UNIT-IV	**DYNAMIC PROGRAMMING**	**9**

Bellman’s principle of optimality - Representation of a multistage decision problem- concept ofsub-optimization problems using classical and tabular methods.

UNIT-V :	**STRUCTURAL APPLICATIONS**	**9**

Methods for optimal design of structural elements, continuous beams and single storiedframes using plastic theory -Minimum weight design for truss members - Fully stressed design- Optimization principles to design of R.C. structures such as multistory buildings, water tanksand bridges.

TOTAL : 45 PERIODS

REFERENCES:

1. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West PressLtd, New Delhi, 1997
2. Rao,S.S. "Engineering Optimization: Theory and Practice", Fourth Edition, Wiley Eastern(P) Ltd., 2013.
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering MechanicsServices, Prentice-Hall, New Jersey 1971.
4. Uri Kirsch, "Optimum Structural Design", McGraw Hill Book Co. 1981.
5. Haftka, R. T. and Gurdal, Z., Elements of Structural Optimization, Springer, 3 rd Edition,1992

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	DESIGN OF HIGH RISE STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the behaviour, analysis and design of high rise structures.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about fundamentals to understand the design criteriaand structural forms of tall buildings.
2	To Identify the effects of loading in high rise structures.
3	To design the special structures such as chimneys and cooling towers.
4	To Analyze and design the transmission tower and TV towers.
5	To study about software to analyze the engineering problems.

COURSE OUTCOMES

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

CO1	Apply the knowledge of engineering fundamentals to understand the design criteriaand structural forms of tall buildings.	Understand
CO2	Identify the effects of loading in high rise structures.	Understand
CO3	Design the special structures such as chimneys and cooling towers.	Apply
CO4	Analyze and design the transmission tower and TV towers.	Apply
CO5	Select the modern sophisticated software to analyze the engineering problems.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	-	-	-	-	M	-	M	-	-	M	-	-
CO2	-	M	-	-	-	-	-	-	-	L	-	-	S	M	M
CO3	-	M	S	-	M	M	-	-	-	M	-	-	S	S	H
CO4	-	S	-	-	S	S	-	-	-	-	-	-	S	S	M

CO5	S	S	-	L	S	S	M	S	M	-	L	L	S	M	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**DESIGN CRITERIA**	**9**

High rise buildings – Structural systems and concepts, configurations - Design philosophy,Introduction to Performance based seismic design, Effect of openings. Large panel construction.Foundation - superstructure interaction.

UNIT-II :	**LOADING**	**9**

Gravity loading: Dead and live load, methods of live load reduction, Impact loads, Constructionloads. Wind loading: static and dynamic approach, Analytical and wind tunnel experimentationmethod. Earthquake loading: Equivalent lateral force, modal analysis - Combinations of loading.

UNIT-III :	**DESIGN OF CHIMNEYS**	**9**

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – CoolingTowers - Tall Chimneys – Foundation design for varied soil strata.

UNIT-IV	**ANALYSIS AND DESIGN OF TRANSMISSION TOWER**	**9**

Mast and trestles: Configuration, bracing system, analysis and design of Transmission towers –TV towers and steel monopoles.

UNIT-V :	**APPLICATION OF MODERN SOFTWARE**	**9**

Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis,Modelling and analysis using recent softwares viz SAP 2000, ETABS and STAAD Pro.

TOTAL : 45 PERIODS

REFERENCES:

1. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, CRC Press, 2011.
2. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
3. Smith B.S and Coull A, “Tall Building Structures - Analysis and Design”, John Wiley andSons, Inc., 2011.
4. Holmes, “Wind Loading of Structures, Third Edition, Spon Press, London, 2017
5. Schuller W. G, “High rise building structures”- John Wiley,1977.

S.No.	Name of the Faculty	Designation	Name of the College	Mail ID

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	DESIGN OF OFFSHORE STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To impart knowledge about the concept of wave theories, forces, offshore foundation,analysis and design of jacket towers, pipes and cables**.**

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about the concept of wave theories
2	To study about wave forces and offshore structures
3	To study aboutthe modeling for offshore structure and its foundation
4	To Analyse offshore structures by means of static and dynamic methods
5	To design of jacket towers, mooring cables and pipelines

COURSE OUTCOMES

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

CO1	Develop the concept of wave theories	Understand
CO2	Apply the knowledge of wave forces and offshore structures	Apply
CO3	Explain the modeling for offshore structure and its foundation	Understand
CO4	Analyse offshore structures by means of static and dynamic methods	Apply
CO5	Design of jacket towers, mooring cables and pipelines	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	M	-	-	M	S	L	-	-	L	S	L	S
CO2	S	-	-	M	-	M	M	S	L	-	-	L	S	L	S
CO3	S	M	-	M	S	S	M	S	-	M	M	M	S	S	S
CO4	M	S	S	M	S	M	M	S	-	M	-	M	S	S	S
CO5	M	S	S	M	S	M	M	S	-	M	-	M	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**WAVE THEORIES**	**9**

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT-II :	**FORCES OF OFFSHORE STRUCTURES**	**9**

Wind forces, wave forces on small bodies and large bodies - current forces – Morison equation

UNIT-III :	**OFFSHORE SOIL AND STRUCTURE MODELLING**	**9**

Different types of offshore structures, foundation modeling, fixed jacket platform structuralmodeling.

UNIT-IV	**ANALYSIS OF OFFSHORE STRUCTURES**	**9**

Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT-V :	**DESIGN OF OFFSHORE STRUCTURES**	**9**

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines

TOTAL : 45 PERIODS

REFERENCES:

1. Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
2. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, Springer – verlag, 2003.
3. Chakrabarti, S.K. 1994, Offshore Structure Modelling: World Scientific
4. Chandrasekaran, S. 2017. Dynamic analysis and design of ocean structures.
5. B. Gou, S.Song, J Chacko and A. Ghalambar, offshore pipelines, GPP publishers, 2006.

S.No.	Name of the Faculty	Designation	Name of the College	Mail ID
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2.	Mrs.MAbirami R	AP/Civil	AVIT	abirami.civil@avit.ac.in

	PERFORMANCE OF STRUCTURES WITH SOIL STRUCTURE INTERACTION	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the concept of soil-structure – interaction in the analysis and design of structures.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study the concept of soil structure interaction.
2	To study the soil structure interaction and estimate the contact pressure and settlement
3	To study the dynamic analysis of soil structure interaction problems
4	To study the various SSI models
5	To Analyze structural elements like shallow, Raft and pile foundation and analyze highrise building bases

COURSE OUTCOMES

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

CO1	Explain the concept of soil structure interaction.	Understand
CO2	Do a static analysis of soil structure interaction and estimate the contact pressureand settlement	Apply
CO3	Do a dynamic analysis of soil structure interaction problems	Apply
CO4	Explain the various SSI models	Understand
CO5	Analyze structural elements like shallow, Raft and pile foundation and analyze highrise building bases	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	M	S	M	L	L	L	L	L	L	S	S	S	M
CO2	S	S	M	S	M	L	L	L	L	L	L	M	S	S	M

CO3	S	S	M	S	M	L	L	L	L	L	L	M	S	S	M
CO4	S	S	M	S	M	L	L	L	L	L	L	S	S	S	M
CO5	S	S	SS	S	M	L	L	L	L	L	L	M	S	S	M

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

Introduction to Soil-structure interaction(SSI) problems, history - Static SSI - Dynamic SSI - liquefaction Problems associated with SSI, Case studies

UNIT-II :	**STATIC SSI PROBLEMS**	**9**

Contact pressure and its estimation - Estimation of the settlement from the constitutive laws

UNIT-III :	**DYNAMIC SSI PROBLEMS**	**9**

Free-field response - Kinetic interaction - Inertial interaction

UNIT-IV	**SSI MODELS**	**9**

Winkler model - Elastic continuum-Multi parameter models -Codal provisions of India and others

UNIT-V :	**STRUCTURAL ANALYSIS WITH SSI**	**9**

Shallow foundation & Raft foundation problems - Analysis of high rise building with fixed base andflexible base - SSI consideration in pile foundation - Laterally loaded piles

TOTAL : 45 PERIODS

REFERENCES:

1. John P. Wolf, (1985) Soil-structure interaction, Prentice Hall, 1987.
2. Bowels, J.E., "Analytical and Computer methods in Foundation" McGraw Hill Book Co.,New York., 1974
3. Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGrawHill Book Co. New York.
4. Soil Structure Interaction, the real behaviour of structures, Institution of StructuralEngineers, 1989.
5. A.P.S. Selvadurai, Elastic Analysis of Soil Foundation Interaction, Developments inGeotechnical Engg.vol-17, Elsevier Scientific Publishing Co., 1979.
6. Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice."John Wiley &Sons, New York, 1990.

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	DESIGN OF BRIDGE STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the loads, forces on bridges and design of several types of bridges.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study the types of bridges and design philosophies
2	To design a RC solid slab culvert bridge
3	To design a RC Tee Beam and Slab bridge
4	To design the bridge bearings and substructure

5	To design of PSC bridges, box girder bridges, truss bridges

COURSE OUTCOMES

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

CO1	Explain the different types of bridges and design philosophies	Understand
CO2	Design a RC solid slab culvert bridge	Apply
CO3	Design a RC Tee Beam and Slab bridge	Apply
CO4	Design the bridge bearings and substructure	Apply
CO5	Explain the design of PSC bridges, box girder bridges, truss bridges	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	S	L	M	S	S	L	M	L	S	S	S	S
CO2	S	S	S	M	L	M	S	S	L	M	L	S	S	S	S
CO3	S	S	S	M	L	M	S	S	L	M	L	S	S	S	S
CO4	S	S	S	M	L	M	S	S	L	M	L	S	S	S	S
CO5	S	S	S	M	L	M	S	S	L	M	L	S	S	S	S

S- Strong **M-Medium** **L-Low**

SYLLABUS

UNIT-I :	**INTRODUCTION**	**9**

Introduction- Selection of Site and Initial Decision Process - Classification of Bridges- GeneralFeatures of Design- Standard Loading for Bridge Design as per different codes - Road Bridges –Railway Bridges - Design Codes - Working Stress Method- Limit State Method of Design as perIS456:2000- Limit State Method of Design as per IRC 112:2011

UNIT-II :	**SUPERSTRUCTURES – Part – I**	**9**

Selection of main bridge parameters, design methodologies -Choices of superstructure types - Orthotropic plate theory, load distribution techniques - Grillage analysis - Finite element analysisDifferent types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge. – TransverseAnalysis of Bridge - Analysis and Design of RCC solid slab culverts and bridges

UNIT-III :	**SUPERSTRUCTURES – Part – II**	**9**

Design of RCC Tee beam and slab bridges - Design principles of continuous girder bridges,

boxgirder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges.		
UNIT-IV	**SUBSTRUCTURE, BEARINGS AND DECK JOINTS**	**9**
Pier - Abutment - Wing walls - Importance of Soil-Structure Interaction - Types of foundations -Open foundation - Pile foundation - Well foundation Different types of bridge bearings andexpansion joints; Design of bearings and joints.		
UNIT-V :	**PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES**	**9**
Introduction to Design of PSC bridges – PSC girders – Introduction to design of steel bridges -Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.		
TOTAL : 45 PERIODS		

REFERENCES:

1. Jagadeesh. T.R. and Jayaram. M. A., "Design of Bridge Structures", Second Edition, Prentice Hall of India Pvt. Ltd. 2009.
2. Johnson Victor, D. "Essentials of Bridge Engineering", Sixth Edition, Oxford and IBHPublishing Co. New Delhi, 2018.
3. Ponnuswamy, S., "Bridge Engineering", Third Edition, Tata McGraw Hill, 2017.
4. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi,1991.
5. Design of Highway Bridges, Richard M. Barker & Jay A. Puckett, John Wiley & Sons, Inc.,2007

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	DESIGN OF SHELL AND SPATIAL STRUCTURES	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about the shells and design the domes and shells
2	To study about the structural behaviour and design of folded plate structures
3	To study about the various functional configurations of space frames
4	To design of space frames and apply the knowledge of CAD for the analysis of spacestructures
5	To analyse the configurations of space structures using FORMIAN software

COURSE OUTCOMES

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

CO1	Explain the different forms of shells and design the domes and shells	Understand
CO2	Evaluate the structural behaviour and design of folded plate structures	Apply
CO3	Explain the various functional configurations of space frames	Apply
CO4	Design of space frames and apply the knowledge of CAD for the analysis of spacestructures	Apply
CO5	Analyse the configurations of space structures using FORMIAN software	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	-	-	-	-	-	-	-	-	-	S	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-

CO4	S	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO5	S	-	-	-	M	M	-	-	-	-	-	-	-	-	-

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**CLASSIFICATION OF SHELLS**	**9**

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs,circular cylindrical shells by ASCE Manual No.31.

UNIT-II :	**FOLDED PLATES**	**9**

Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committeemethod – pyramidal roof- Prismoidal roof.

UNIT-III :	**INTRODUCTION TO SPACE FRAME**	**9**

Space frames - configuration - types of nodes - Design Philosophy - Behaviour

UNIT-IV	**ANALYSIS AND DESIGN**	**9**

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to ComputerAided Design.

UNIT-V :	**SPECIAL METHODS**	**9**

Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL : 45 PERIODS

REFERENCES:

1. Billington. D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, 1982.ASCE Manual No.31, Design of Cylindrical Shells.
2. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI LearningPvt. Ltd., 2010.
3. Subramanian.N ,”Space Structures: Principles and Practice”, Multi-Science Publishing Co.Ltd. 2008.
4. Ramasamy, G.S., “Analysis, Design and Construction of Steel Space Frames”, ThomasTelford Publishing, 2002.
5. Wilby.C “Concrete Folded Plate Roofs”, Elsevier, 1998.

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	STRUCTURAL STABILITY	Category	L	T	P	Credit
		EC-PS	3	0	0	3

PREAMBLE

To study the concept of buckling and analysis of structural elements

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To study about of buckling of columns and calculate the buckling load oncolumn by various approaches
2	To determine the buckling load of beam – columns and frames
3	To explore the concepts of torsional and lateral buckling of thin walled members
4	Explain the phenomenon of buckling of plates
5	Analyze the inelastic buckling of columns and plates

COURSE OUTCOMES

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

CO1	Explain the phenomenon of buckling of columns and calculate the buckling load oncolumn by various approaches	Understand
CO2	Estimate the buckling load of beam – columns and frames	Apply
CO3	Explore the concepts of torsional and lateral buckling of thin walled members	Apply
CO4	Explain the phenomenon of buckling of plates	Apply
CO5	Analyze the inelastic buckling of columns and plates	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S
CO2	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S
CO3	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S
CO4	M	S	M	M	L	M	-	-	-	-	-	S	S	S	S

CO5	S	S	S	S	M	M	-	-	-	-	-	S	S	S	S

S- Strong	M-Medium	L-Low

SYLLABUS

UNIT-I :	**BUCKLING OF COLUMNS**	**12**

States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches tostability analysis. Governing equation for column buckling - critical load using Equilibrium, Energymethods - Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques -Finite difference method

UNIT-II :	**BUCKLING OF BEAM-COLUMNS AND FRAMES**	**12**

Theory of beam column - Stability analysis of beam column with single and several concentratedloads, distributed load and end couples - Analysis of rigid jointed frames with and without sway –Use of stability function to determine the critical load.

UNIT-III :	**TORSIONAL AND LATERAL BUCKLING**	**12**

Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of openSections - Lateral buckling of beams - simply supported and cantilever beams.

UNIT-IV	**BUCKLING OF PLATES**	**12**

Governing differential equation - Buckling of thin plates with various edge conditions - Analysis byequilibrium and energy approach – Finite difference method

UNIT-V :	**INELASTIC BUCKLING**	**12**

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loadedinelastic column. Inelastic buckling of plates - Post buckling behaviour of plates.

TOTAL : 60 PERIODS

REFERENCES:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
3. Gambhir.M.L, "Stability Analysis and Design of Structures", springer, New York, 2013.
4. Simitser. G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
5. Timoshenko. S. P, and Gere. J.M, "Theory of Elastic Stability", McGraw Hill BookCompany,1963

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OPEN ELECTIVES ON EMERGING AREAS

	METAL ADDITIVEMANUFACTURING	Category	L	T	P	Credit
		OE--EA	3	0	0	3

Prerequisite:-Nil

CourseObjective

1	Understand the basic principles, methods, areas of usage, possibilities and limitations and the environmental effects of the metal additive manufacturing
2	Select suitable materials for developmentof parts using additive manufacturing with sound mechanical properties
3	Select suitable processes from various metal additive manufacturing processes as per the product requirement
4	Develop and select suitable parameter for manufacturing and post processing techniques for metal additive manufacturing parts
5	Design the parts for metal additive manufacturing

CourseOutcomes:On thesuccessfulcompletionof thecourse,studentswillbeableto

CO1.	Understand the basic principles, applications and limitations metal additive manufacturing system	Understand
CO2.	Understand how to select suitable materials from the existing or develop new materials for additive manufacturing	Understand
CO3.	Understand the working principle of various methods in MAM and their applications and limitation	Understand
CO4.	Produce a defect free MAM parts with suitable material selection and post processing techniques	Apply
CO5.	Understand the design and optimization techniques to design and develop parts using MAM techniques	Apply

Mappingwith ProgrammeOutcomesandProgrammeSpecificOutcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 1	PO 1	PO 1	PS O	PS O	PS O
CO1	M	-	-	-	M	-	M	-	-	-	-	L	L	-	-
CO2	M	-	-	-	M	-	M	-	-	-	-	L	L	-	-
CO3	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M
CO4	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M
CO5		-	-	-		-		-	-	-	-	L	L	-	M

S-Strong;M-Medium;L-Low

Syllabus

Module 1	**Introduction**	9
Introduction to metal additive manufacturing – classification and challenges – applications- CAD for additive manufacturing – file formats, CAD CAM software, modelling and data processing – STL format – slicing – design consideration- machine set up		
Module 2	**Materials and properties of AM printed parts**	9
Manufacturing of metallic materials - Conventional vs AM process - Solidification of Metals Equilibrium and Non-equilibrium phases for solidificationfor AM Phase diagrams - Iron-Carbon - Aluminum alloy - Titanium alloy - Nickel alloy		
Module 3	**Basic processes in metal additive manufacturing**	9
Powder bed fusion – direct energy deposition – binder jetting – metal extrusion – material jetting - sheet lamination Laser theory - Continuous vs pulsed laser - Laser types - Laser beam properties Basics of electron beam - Electron beam powder bed fusion and mechanism		
Module 4	**AM process parameters**	9
Beam Scanning Strategies and Parameters for PBF and DED - Powder Properties for PBF, DED, and BJ- Ambient Parameters for PBF and DED - Geometry-Specific Parameters, Support Structures (PBF) Defects in AM Printed Parts - Need of Post Processing - Need for Surface Finishing		
Module 5	**Design for Additive Manufacturing**	9
Fundamentals and principle -design techniques and steps - design optimization, material selection and consideration in application field- Part decomposition and Decomposition methods Topology optimization techniques - Overhangs, and Bridging and cavities in design Key characteristics and considerations in topology optimization - Topology optimization under		

TextBooks	
1	Milewski, J.O., 2017. Additive manufacturing of metals. Cham: Springer International Publishing.
2	Balasubramanian, K.R. and Senthilkumar, V. eds., 2020. Additive Manufacturing Applications for Metals and Composites. IGI Global.
ReferenceBooks	
1	Leach, R. and Carmignato, S. eds., 2020. Precision Metal Additive Manufacturing. CRC
2	Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003

3	Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
4	Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

CourseDesigners

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1	Mr.A.Elanthirayan	Asst. Prof. G-II	AVIT	aleanthirayan@avit.ac.in

	WASTE TO ENERGY	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

This course is to provide insights into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To enable students to understand of the concept of Waste to Energy.
2	To link legal, technical and management principles for production of energy form waste.
3	To learn about the best available technologies for waste to energy.
4	To analyze of case studies for understanding success and failures.

COURSE OUTCOMES

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

CO1: Understand the knowledge about the operations of Waste to Energy Plants.	Understand
CO2: Analyse the various aspects of Waste to Energy Management Systems.	Analyze
CO3: Carry out Techno-economic feasibility for Waste to Energy Plants	Apply
CO4: Evaluate planning and operations of Waste to Energy plants.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PS O2	PSO3
CO1	M	-	-	L	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	L	L	-	M	-	-	-	-	-	-	L	-	-
CO3	S	M	S	M	-	L	-	M	-	-	-	-	M	L	-
CO4	S	M	S	-	L	-	-	-	-	-	-	-	M	L	-
CO5	L	L	-	L	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of

Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

WASTE SOURCES & CHARACTERIZATION

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

TECHNOLOGIES FOR WASTE TO ENERGY

Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

WASTE TO ENERGY OPTIONS

Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Conversion of wastes to fuel resources for other useful energy applicationsEnergy from Plastic Wastes – Non-recyclable plastic wastes for energy recovery. Energy Recovery from wastes and optimization of its use, benchmarking and standardization. Energy Analysis.

CASE STUDIES -WASTE TO ENERGY PLANTS

Success/failures of waste to energy Global Best Practices in Waste to energy production distribution and use. Indian Scenario on Waste to Energy production distribution and use in India. Success and Failures of Indian Waste to Energy plants. Role of the Government in promoting 'Waste to Energy'. Waste activities – collection, segregation, transportation and storage requirements. Location and Siting of 'Waste to Energy' plants. Industry Specific Applications – In-house use – sugar, distillery, pharmaceuticals, Pulp and paper, refinery and petrochemical industry and any other industry. Centralized and Decentralized Energy production, distribution and use. Comparison of Centralized and decentralized systems and its operations.

REFERENCES

1. Lee, James M., "Biochemical Engineering." PHI, 1st Edition, 1992. Yeh W.K., Yang H.C., James R.M., "Enzyme Technologies: Metagenomics, Biocatalysis and Biosynsthesis", Wiley- Blackwell, 1st Edition, 2010. Blanch H.W., Clark D. S., "Biochemical Engineering", Marcel Dekker, Inc. 2nd Edition, 1997.
2. Palmer, Trevor. "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry." 2nd Edition, East West Press, 2008.

Course Designers

S.No	Name of the faculty	Designation	Department	Mail ID

.				
1.	Dr.R. Kirubakaran	Assistant Professor	Department of Biotechnology	kirubakaran@vmkvec.edu.in
2	Dr.M.Sridevi	Professor	Biotechnology	hodbte@vmkvec.edu.in

	BIOMEDICAL PRODUCT DESIGN AND DEVELOPMENT	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To understand the global trends and development methodologies of various types of products and services.
2	To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
3	To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
4	To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
5	To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

COURSE OUTCOMES

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

CO1. Define, formulate and analyze a problem for the product design.	Apply
CO2 Obtain the domain knowledge of product development and regulatory requirements for the design of prototype.	Apply
CO3. Explain the process of manufacturing, testing and validation for scalable product development.	Apply
CO4 Gain knowledge of the Innovation & Product Development process in the Business Context.	Apply
CO5 Discuss the economics in product development and business strategies for turnover from commercialization.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO2	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO3	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO4	S	S	S	L	--	--	--	M	--	--	--	M	S	L	M
CO5	S	S	S	L	--	--	--	M	--	--	--	M	S	L	M

S- Strong; M-Medium; L-Low

SYLLABUS

PRODUCT DESIGN

Definition, History and Modern Practice – Designs; Design and Product Life Cycle; Design Process; What is a medical device, Challenges in medical device, Understanding the innovation cycle, Good Design Practice.

Understanding, analyzing and validating user needs, Screening Needs, Technical Requirements, Concept Generation – Innovation Survey Questionnaire, Morphological Matrix, QFD, Concept Analysis and validation, Concept Modelling, Concept Screening & Validation.

PRODUCT DEVELOPMENT AND REGULATORY

Breakthrough Products, Platform Products, Front End of Innovations / Fuzzy Front End, Generic Product Development Process (Concept Development, System Design, Detailed Design, Test & Refinement, Production Ramp-up), Variants of Development Processes (Market Pull, Technology Push, Platform, Process-Intensive, Customized, High-Risk, Quick Build, Complex Systems), Good Documentation Practice, Prototyping Specifications, Prototyping, Medical Device standards, Quality management systems, Medical Device Classification, Design of Clinical Trials, Design Control & Regulatory Requirements, Documentation in Medical Devices, Regulatory pathways.

CALABLE PRODUCT DEVELOPMENT

Design for manufacturing, Design for assembly, Design for Serviceability, Design for usability, Medical Device Verification & Validation, Product Testing & Regulatory compliance, Clinical trial & validation, Device Certification.

MANUFACTURING AND BUSINESS STRATEGIES

Lean Manufacturing – Toyota Production System, Good Manufacturing Practices, Framework for Product Strategy – Core Strategic Vision (CSV), Characteristics of good CSV, Opportunity Identification Process & Generating Opportunities, Quality of Opportunities – Real-Win-Worth It (3M RWW), Product Planning Process, Technology S-Curve, Evaluating and Prioritizing Projects, Product-Process Change Matrix, Resource Planning, Total Available Market (Segmentation, Targeting & Positioning), Served Available Market, Product Platform Strategy, Market Platform Plan (Product Platform Management, Product Line Strategy).

PRODUCT ECONOMICS AND MARKET INFUSIONS

Economics/Finance in Product Development (Sales Forecasting – ATAR Model/ Bases Model, Pricing the product, Cash flow in Product Development, Categorizing the costs, Structuring Manufacturing Costs, Prototyping Costs, Development Costs, Cost Volume Profit Analysis, Breakeven Analysis, Common Return Metrics – Payback/ NPV/ IRR, Common Comparison Metrics – WACC/ RRR/ MARR). Business Model Canvas, Marketing Channels, Sales Models, Post Commercialization Surveillance, End of Life support.

REFERENCES:

1. Jones, J.C., Design Methods, John Wiley, 1981.
2. Cross, N., Engineering Design Methods, John Wiley, 1994.
3. Pahl, G., and Beitz, W., Engineering Design, Design Council, 1984.
4. Michael E. McGrath, Product Strategy for High-Technology Companies, 2nd Edition, McGraw Hill.
5. Ulrich, K.T., and Eppinger, S.D., Product Design and Development, Tata McGraw Hill, India.
6. Ehrelspiel. K, and Lindemann U Cost Efficient Design, Springer,2007.
7. Paul H king, Richard C. Fries, Arthur T. Johnson, Design of Biomedical Devices and Systems. Third edition, ISBN 9781466569133.
8. Peter J. Ogrodnik, Medical Device Design: Innovation from Concept to Market, Academic Press Inc; Edition (2012), ISBN- 10:0123919428.
9. Stefanos Zenios, Josh Makower, Paul Yock, Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel, Biodesign: the Process of Innovating Medical Technologies, Cambridbge University press; Edition (2009), ISBN- 10:0521517427.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID

1	Dr.L.K.Hema	Professor& Head	BME& ECE	hodbme@avit.ac.in
2	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
3	Dr.R.Ezhilan	Assistant Professor	BME	ezhilan@vmkvec.edu.in

	ADVANCED CYBER SECURITY	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

To understand the need for Cyber Security in real time and to study techniques involved in it.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	To understand the basic terminologies related to cyber security and current cyber security threat landscape.
2.	To unserstand the cyberattacks that target computers, mobiles and persons
3.	To understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes
4.	To study the data privacy and security issues related to Social media platforms.
5.	To understand the main components of cyber security plan

COURSE OUTCOMES

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

CO1:able to understand the basic terminologies related to cyber security and current cyber security threat landscape.	Understand
CO2: Able to complete u n d e r s t a n d i n g of the cyberattacks that target computers, mobiles and persons	Apply
CO3:able to understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes, It will also expose students to limitations of existing IT Act,2000 legal framework that is followed in other countries and legal and ethical aspects related to new technologies.	Apply
CO4: Able to get insight into the Data Protection Bill,2019 and data privacy and security issues related to Social media platforms.	Apply
CO5:Able to understand the main components of cyber security plan.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M

CO2	M	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	M	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M		-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	S	-	-	-	-	-	-	-	M	M	S
S- Strong; M-Medium; L-Low															

SYLLABUS:

Overview of Cyber security **9 hours**
Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.
Cyber crimes **9 hours**
Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.
Cyber Law **9 hours**
Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.
Data Privacy and Data Security **9 hours**
Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.
Cyber security M a n a g e m e n t , Compliance and Governance **9 hours**
Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.
REFERENCES

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by SumitBelapure and Nina Godbole, Wiley India Pvt. Ltd.

2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.

3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.

4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.

5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.

6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.R.Jaichandran	Assistant professor G-II	CSE	rjaichandran@avit.ac.in
2.	Mr. B. Sundharamurthy	Assistant Professor	CSE	sundharamurthy@vmkvec.edu.in

	BIO MEMS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The rapid development of the integrated circuit (IC) industry has led to the emergence of micro electronics process engineering as a new advanced discipline. The combination of MEMS and integrated intelligence has been put forward as a disruptive technology.Gives brief knowledge about applications of Bio-MEMS technology for therapeutics and diagnostics.

PREREQUISITE

Nil

COURSE OBJECTIVES

1	To train the students in the design aspects of Bio MEMS devices and Systems.
2	To learn the basic principles of BioMEMS/Microfluidic device manufacturing.
3	To make the students aware of applications in various medical specialists especially the Comparison of conventions methods and Bio MEMS usage.
4	To Classify the different mechanisms of micro sensors and actuators.

COURSE OUTCOMES

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

CO1. Understand the Micro fluidic Principles and study its applications.	Understand
CO2. Explain the principles and applications of Micro Total Analysis.	Understand
CO3. Discuss and realize the MEMS applications in Bio Medical Engineering	Understand
CO4. Classifying the principles of Micro Actuators and Drug Delivery system	Apply
CO5.Utilizing the concept of MEMS with biological applications	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	L	-	-	-	-	-	-	-	-	-	-
CO2	S	L	L	L	M	-	-	-	-	-	-	-	-	-	-
CO3	S	L	M	L	M	-	-	-	-	-	-	-	-	L	-
CO4	S	M	M	L	M	-	-	-	-	-	-	L	L	L	-
CO5	S	S	M	L	M	-	-	-	-	-	-	L	L	L	-

S- Strong; M-Medium; L-Low

SYLLABUS

Unit I

Introduction-The driving force behind Biomedical Applications – Biocompatibility - Reliability Considerations-Regularity Considerations – Organizations - Education of Bio MEMS-Silicon Micro fabrication-Soft Fabrication techniques

Unit II

Micro fluidic Principles- Introduction-Transport Processes- Electro kinetic Phenomena-Micro valves –Micro mixers-Micro pumps.

Unit III

SENSOR PRINCIPLES and MICRO SENSORS: Introduction-Fabrication-Basic Sensors-Optical fibers-Piezo electricity and SAW devices-Electrochemical detection-Applications in Medicine

Unit IV

MICRO ACTUATORS and DRUG DELIVERY: Introduction-Activation Methods-Micro actuators for Micro fluidics-equivalent circuit representation-Drug Delivery

Unit V

MICRO TOTAL ANALYSIS: Lab on Chip-Capillary Electrophoresis Arrays-cell, molecule and Particle Handling-Surface Modification-Microsphere-Cell based Bioassay Systems Detection and Measurement Methods-Emerging Bio MEMS Technology-Packaging, Power, Data and RF Safety-Biocompatibility, Standards

Text Books/ References Books :

1. Steven S. Saliterman, Fundamentals of Bio MEMS and Medical Micro devices, Wiley Interscience, 2006.
2. Albert Folch , Introduction to Bio MEMS, CRC Press, 2012
3. Gerald A. Urban, Bio MEMS, Springer, 2006
4. Wanjunwang, steven A. Soper, Bio MEMS, 2006.
5. M. J. Madou, “Fundamentals of Micro fabrication”,2002.

6. G.T. A. Kovacs, “Micro machined Transducers Sourcebook”, 1998.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.A.Malarvizhi	Assistant Professor	ECE	malarvizhi@vmkvec.edu.in
2	Dr.T.Muthumanickam	Professor & Head	ECE	muthumanickam@vmkvec.edu.in

	SOLARANDENERGYSTORAGESYSTEMS	Category	L	T	P	C
		OE-EA	3	0	0	3

PREAMBLE

ThissubjectdealswiththegeneralconceptofSolarandEnergyStorageSystems,andimprovement.

PREREQUISITE:Nil

COURSEOBJECTIVE

1.	Toexplainbasicsofsolarphotovoltaicsystemsandenergystoragesystem
2.	Tounderstandtheconceptsandvariouscomponentsofstand-alonesystem
3.	Togainthesoundknowledgeaboutgridconnected PVsystem
4.	ToknowthedesignofvariousPV-interconnectedsystems.
5.	Toprovidetheknowledgeaboutthevariousapplicationsofsolarsystem

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto	Understand
CO1:Describethebasicsofsolarsystem.	Understand
CO2:RecognizetheconceptsofstandalonePVsystem.	Analysis
CO3:Designthegridconnectedsystemforvariousapplications.	Analysis
CO4:Selectthesuitablestoragesystemforparticularapplications.	Analysis
CO5:Recognizethevariousapplicationsofsolarsystem.	Create

Mappingwithprogrammeoutcomesandprogrammespecificoutcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	M	S	S	M	-	-	L	-	M	-	M
CO2	S	S	-	-	M	S	S	M	-	-	L	-	L	-	L
CO3	S	S	L	-	S	S	S	M	-	-	M	-	M	L	L
CO4	S	M	L	M	S	S	M	M	-	-	M	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG,M-MEDIUM,L-LOW

Introduction
Characteristics of sunlight: the sun and its radiation, Solar radiation, Direct and diffusion radiation,greenhouseeffect,solarisolationdataandestimation-semiconductorsandP-Njunctions:semiconductorsand types, absorption of light, recombination and PN junctions –behavior of solar cells – cell properties:efficiencyandlosses,Topcontactdesign,Lasergrooved,Buriedcontactsolarcell–PVcellinterconnection:Module and circuitdesign, Environmentaland thermal protection.

Stand-alonePVSystem
Solarmodules–storagesystems:Types,applications,requirements,efficiency,Leadacidbatteries–powerconditioning and regulation: Diodes, Regulators, Inverters- Balance of system components - protection –standalonePVsystems design–sizing:Reliability maps,sizingforhighreliability,existingmethods.

GridConnectedPVSystems
PV systems in buildings – Utility applications for photo voltaic – design issues for central power stations – safety– Economic aspect – Efficiency and performance - International PV programs – Integration of PV andWind –Indian SpecificStandard for Integration.

EnergyStorageSystems
Impactofintermittentgeneration:Wind,gasandcoalintegration,impactsofcycling,PSCOcasestudies–Battery energy storage–solar thermal energy storage–pumped hydroelectricenergystorage.

Applications
Waterpumping–batterychargers–solarcar–direct-driveapplications–Space–Telecommunications.1

TotalHours=45

Textbook(s):
1. SolarEnergy–S.P.Sukhatme,TataMcGrawHill,2017.
2. StuartR.Wenham,MartinA.Green,MurielE.WattandRichardCorkish,“AppliedPhotovoltaics”,2011.

Reference(s):
1. FrankS.Barnes&JonahG.Levine,“LargeEnergystorageSystemsHandbook”, CRCPress,2017.
2. S.Sumathi,“SolarPVandWindEnergyConversionSystems(GreenEnergyandTechnology)”,L.Ashok Kumar, P. Surekha,2015.
3https://nptel.ac.in/courses/112/105/112105051/
4https://nptel.ac.in/content/storage2/courses/108103009/download/M9.pdf

COURSEDESIGNERS

S. No	Nameofthe faculty	Designation	Department	Mail-id
1.	Mr.A.Balamurugan	AP	EEE	balamurugan@vmkvec.edu.in
2.	Mr.V.Rattan Kumar	AP(Gr-II)	EEE	rattankumar@avit.ac.in

	TECHNICAL SEMINAR	Category	L	T	P	Credit
		EE-S	0	0	2	1

COURSE OBJECTIVES

- To work on a specific technical topic in advanced topics in Civil Engineering in order to acquire the skillsof oral presentation and to acquire technical writing abilities for seminars and conferences.

Employability Enhancement Courses

COURSE OUTCOMES

On completion of the course, the student is expected to be able to acquire the skills of oralpresentation and to acquire technical writing abilities for seminars and conferences.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	S	-	M	M	-	S	S	-	-	M	-	M	S	-	S

S- Strong **M-Medium** **L-Low**

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 advanced topics in Civil Engineering and toengage 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 thirtyminutes on the technical topic. They will also answer the queries on the topic. The students asaudience also should interact. Evaluation will be based on the technical presentation and report submitted.

TOTAL : 30 PERIODS

AUDIT COURSES

	ENGLISHFORRESEARCHPAPER WRITING	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

Thiscourseisdesignedtoimprovethe writingskills,levelofreadabilityofthelearner andskillsfor writingthetitle.

PREREQUISITE

Nil

COURSEOBJECTIVES

1	Understandthathowtoimproveyourwritingskillsandlevelofreadability
2	Learnabout whattowritein eachsection
3	UnderstandtheskillsneededwhenwritingaTitle
4	Ensurethegoodqualityofpaperatveryfirst-timesubmission

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1.Understandhowtoimproveyourwritingskillswithconcisenessso asto andremovingredundancy	Understand
CO2.Classifythesectionsinvolvedinresearchpaperwriting	Understand
CO3.Interpretthesequenceofresearchfindingswithresults	Apply
CO4.Usevariousparaphrasingmethodtoprovide goodqualitypaperatveryfirst-timesubmission	Apply

MAPPINGWITH PROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	-	-	-	-	-	-	M	-	-	M	-	-	S
CO2	L	M	-	-	M	-	-	-	M	-	-	M	-	-	S
CO3	L	M	-	-	M	-	-	-	M	-	-	M	-	-	S
CO4	L	M	-	-	M	-	-	-	M	-	-	M	-	-	S

S-Strong;M-Medium;L-Low

SYLLABUS

UnitI
PlanningandPreparation,WordOrder,Breakinguplongsentences,StructuringParagraphsandSentences,BeingConciseandRemovingRedundancy,AvoidingAmbiguityandVagueness

UnitII
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, SectionsofaPaper,Abstracts.Introduction

UnitIII
ReviewoftheLiterature,Methods,Results,Discussion,Conclusions,TheFinalCheck,keyskillsareneededwhenwritinga Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills neededwhenwritingaReviewoftheLiterature

UnitIV
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing theDiscussion,skillsareneededwhenwritingtheConclusions

Unit V
Usefulphrases,howtoensure paperis asgoodasit couldpossiblybethe first- time submission

TextBooks/ReferencesBooks:

1. GoldbortR(2006)WritingforScience,YaleUniversityPress(availableonGoogleBooks)
2. DayR(2006)HowtoWriteandPublishaScientificPaper,CambridgeUniversityPress
3. HighmanN(1998),HandbookofWritingfortheMathematicalSciences, SIAM.Highman'sbook
4. AdrianWallwork,EnglishforWritingResearchPapers,SpringerNewYorkDordrechtHeidelberg London,2011

COURSEDESIGNERS

S.No	Nameofthe Faculty	Designation	Department	MailID
1.	Dr.JenniferGJoseph	HoD-H&S	AVIT	Jennifer@avit.a.cin
2.	Mr.TyndaleCicil	AssistantProfessor	AVIT	tyndale.english@avit.ac.in

	VALUEEDUCATION	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

Thecoursehighlightstheimportanceofvaluesandethicsfor humanlifeandorganization.

PREREQUISITE

Nil

COURSEOBJECTIVES

1	Tounderstand valueofeducationand self-development
2	Toinculcategoodvaluesinstudentstomakethempatriotic withhumanity
3	Togroomthepersonalitywithpositivethinkingwithuniversalbrotherhoodandreligioustolerance.
4	Toimpartthevalueoftruefriendshipandhappiness
5	Toenhancethecharacterandcompetencefordevelopingintoself-control person

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1.Identifythevalueofeducationandself-developmentwithworkethics	Remember
CO2.Interpretsenseofdutieswithgoodvaluesinstudentstomakethempatrioticwithhumanity	Understand
CO3.Explaintheintegration,scientificattitude,overall personalitywith labordignity	Understand
CO4.Discussthevalueoftruefriendshipandhappiness	Understand
CO5.Paraphrasethecharacterandcompetencefor developingintoself-controlperson	Understand

MAPPINGWITH PROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	-	-	-	-	-	S	-	L	-	-	-	-	-
CO2	L	L	-	-	-	-	-	M	-	-	-	-	-	-	-
CO3	L	L	M	-	-	-	-	M	-	-	-	L	L	L	-
CO4	L	S	-	-	-	-	-	M	-	-	-	-	-	-	-
CO5	L	S	M	-	-	-	-	M	-	L	-	-	L	L	-

S-Strong;M-Medium;L-Low

SYLLABUS

UnitI

Valuesandself-development–Socialvaluesandindividualattitudes,Workethics,Indianvisionofhumanism,Moralandnon-moralvaluation.Standardsandprinciples,valuejudgements

UnitII

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration, Truthfulness,Cleanliness,Honesty,Humanity.Poweroffaith,NationalUnity,Patriotism,Lovefornature,Discipline

UnitIII

PersonalityandBehaviorDevelopment-Soul andScientificattitude, Positive Thinking.Integrityanddiscipline.,Punctuality, Love and Kindness, avoid fault Thinking, Free from anger, Dignity of labor, Universal brotherhood andreligioustolerance

UnitIV

True friendship,Happiness Vssuffering, love for truth, Awareof self-destructivehabits,Associationand Cooperation,doingbestforsavingnature

Unit V

CharacterandCompetence–HolybooksvsBlindfaith,Self-managementandgoodhealth,Scienceofreincarnation,Equality,Nonviolence, Humility, Role of Women, all religions and same message, mind your Mind, Self-control, Honesty, Studyingeffectively

TextBooks/ReferencesBooks:

1.Chakroborty,S.K.“ValuesandEthicsfororganizationsTheoryandpractice”,OxfordUniversityPress,NewDelhi

Course Code	CourseTitle	category	L	T	P	C
	CONSTITUTION OF INDIA	**AC**	0	0	2	0

CourseObjectives:
Oncompletionofthiscourse,thestudentswillbeable:

1 TounderstandthenatureandthePhilosophyoftheConstitution.

2 TounderstandtheoutstandingFeaturesoftheIndianConstitutionandNatureoftheFederalsys tem.3ToAnalysePanchayatRajinstitutionsasatoolofdecentralization.
4 ToUnderstand
andanalysethethreewingsofthestateinthecontemporaryscenario.5ToAnalyse RoleofAdjudicatoryProcess.
5 ToUnderstand andEvaluatetherecenttrendsintheIndianJudiciary.

Cours
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TheConstitution-Introduction

The Historical background andmaking of the Indian Constitution –Features of theIndian Constitution-PreambleandtheBasic Structure-FundamentalRightsandFundamentalDuties– DirectivePrinciplesStatePolicy

UNITII–GovernmentoftheUnion

TheUnionExecutive-PowersanddutiesofPresident–PrimeMinisterandCouncilofMinisters-LokSabhaandRajyaSabha

UNITIII–Government oftheStates

TheGovernor–RoleandPowers-CheifMinisterandCouncilofMinisters-StateLegislature

UNITIV–LocalGovernment

TheNewsystemofPanchayats,MunicipalitiesandCo-OperativeSocieties

UNITV–Elections

PowersofLegislature-RoleofChiefElectionCommissioner-StateElectionCommission

TEXTBOOKSANDREFERENCEBOOKS:

1EthicsandPoliticsofthe IndianConstitutionRajeevBhargavaOxford UniversityPress,NewDelhi,

20082TheConstitutionofIndiaB.L.FadiaSahityaBhawan;Newedition(2017)

3IntroductiontotheConstitutionofIndiaDDBasuLexisNexis;Twenty-Fourth2020editionSuggested

TotalHours:30hours

Software/LearningWebsites:

1.https://www.constitution.org/cons/india/const.html2.

http://www.legislative.gov.in/constitution-of-india3.https://www.sci.gov.in/constitution

4.https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-ofindia/

AlternativeNPTEL/SWAYAMCourse:

S.NO	NPTEL ID	NPTEL CourseTitle	CourseInstructor
1	12910600	CONSTITUTION OF INDIA ANDENVIRONMENTAL GOVERNANCE:ADMINISTRATIVE ANDADJUDICATORYPROCESS	PROF.M.K.RAMESHNATIONAL LAWSCHOOL OF INDIAUNIVERSITY

COURSEDESIGNER				
S.NO	**NAME OFTHEFACULTY**	**DESIGNATION**	**NAMEOFTHEINSTITUTION**	**MAILID**
1	Dr.Sudheer	Principal	AVSchoolofLaw	Sudheersurya18@gmail.com

	PEDAGOGYSTUDIES	Category	L	T	P	Credit
		AC	0	0	2	0

PREAMBLE

Thecourseisdesignedtoprovidepedagogicalpracticestowardsacademic,researchactivitiesandprofessional developments.

PREREQUISITE

Nil

COURSEOBJECTIVES

1	Toprovidetheories andmethodologiesrelatedto curriculumdevelopmentandresearchframework
2	Tofamiliarizewithpedagogicalpracticesinformalandinformalclassroomsindevelopingcountries
3	Toidentifyevidenceontheeffectivenessofthepedagogicalpracticesforenhancingteachingandlearning Methods
4	Tounderstand thelearningandresourcebarriers while handlinglargeclasses
5	Toidentifycriticalevidencegapstoguidethedevelopment

COURSEOUTCOMES

Onthesuccessfulcompletionofthecourse,studentswillbeableto

CO1.Identifytheoriesandmethodologiesrelatedtocurriculumdevelopmentandresearchframework	Remember
CO2.Interpretpedagogicalpracticesinformalandinformalclassroomsindevelopingcountries	Understand
CO3.Drawa chartonthe effectivenessofthepedagogicalpracticesforenhancingteaching andlearningmethods	Apply
CO4.Explorethelearningandresourcebarrierswhilehandlinglargeclasses	Analyze
CO5.Examinecriticalevidencegapstoguidethedevelopment	Analyze

MAPPINGWITH PROGRAMMEOUTCOMESANDPROGRAMMESPECIFICOUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	-	-	-	-	-	-	-	L	-	-	-	-	-
CO2	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	L	M	-	-	-	-	-	-	-	-	L	L	L	-
CO4	L	S	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	L	S	M	-	-	-	-	-	-	L	-	-	L	L	-

S-Strong;M-Medium;L-Low

SYLLABUS

UnitI

IntroductionandMethodology,Aimsandrationale,Policybackground,Conceptualframeworkandterminology,Theoriesof learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology andsearching.

UnitII

Thematic overview: Pedagogical practices are being used by teachers in formaland informal classrooms in developingcountries,Curriculum,Teachereducation.

UnitIII

Evidenceontheeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:qualityassessmentofincludedstudies, How can teacher education (curriculum and practicum) and the schoolcurriculum and guidance materials bestsupporteffectivepedagogy,Theoryofchange,Strengthandnatureofthebodyofevidenceforeffectivepedagogicalpractices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogicstrategies.

UnitIV

Professionaldevelopment:alignmentwithclassroompracticesandfollowupsupport,Peersupport,Supportfromthehead teacherand thecommunity,Curriculumandassessment,Barriers to learning: limitedresources andlargeclasssizes.

Unit V

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment,Disseminationand research impact.

TextBooks/ReferencesBooks:

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare,31(2):245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,JournalofCurriculumStudies,36(3):361-379.
3. AkyeampongK(2003)TeachertraininginGhana-doesitcount?Multi-siteteachereducationresearchproject(MUSTER)countryreport1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning ofbasicmaths andreading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.

Course Code	CourseTitle	Category	L	T	P	C
	PersonalityDevelopmentThrough LifeEnlightenSkills	**AC**	0	0	2	0

CourseObjectives:

1. TohelpthelearnerunderstandthebasicsofPersonalityanditscorrelationtosociety.
2. To understandtheroleofAttitudeandmotivationintheenhancementofpersonality.
3. Toapplytheconcepts learntin heighteningtheselfesteem.
4. Toanalysethemostefficientmethodtodevelopthepersonalityandprepareforemployment .

UNITI-IntroductiontoPersonalityDevelopment

The concept of personality - Dimensions of personality – Theories of Freud & Erickson- Significance of personalitydevelopment.Theconceptofsuccessandfailure:Whatissuccess?-Hurdlesinachievingsuccess-Overcominghurdles-Factorsresponsibleforsuccess–Whatisfailure-Causesoffailure.SWOTanalysis.

UNITIIAttitude&Motivation

Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude-Disadvantages-Waystodeveloppositiveattitude-Differencesbetweenpersonalitieshavingpositiveandnegativeattitude.Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading tode-motivation

UNITIIISelf-esteem

Term self-esteem - Symptoms - Advantages - Do's and Don’ts to develop positive self-esteem – Low self-esteem -Symptoms-Personalityhavinglowselfesteem-Positiveandnegativeselfesteem.InterpersonalRelationships–Definingthedifferencebetweenaggressive,submissiveandassertivebehaviours-Lateralthinking.

UNITIVOtherAspectsofPersonalityDevelopment

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualitiesofasuccessful leader– Characterbuilding-Team-work–Timemanagement-Workethics–Goodmannersand etiquette.**UNITVEmployabilityQuotient**

Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -FrequentlyAskedQuestions-PsychometricAnalysis-MockInterviewSessions.

Total:45Periods

TextBooks:1.Hurlock,E.B(2006).PersonalityDevelopment,28thReprint.NewDelhi:TataMcGraw Hill.2.StephenP.RobbinsandTimothyA.Judge(2014),OrganizationalBehavior16thEdition:Prenti ceHall.

COURSEDESIGNERS			
COURSEINSTRUCTOR	**DESIGNATION**	**NAMEOFTHE INSTITUTION**	**MAILID**
Dr.Jennifer GJoseph	HoD-H&S	AVIT	Jennifer@avit.a.cin
Mr.TyndaleCicil	AssistantProfessor	AVIT	tyndale.english@avit.ac.in