		Walcl	hand College ((Government Aidea				
				2021-22			
			Course l	Information			
Progra	amme		M. Tech. (Structu	ıral Engineerin	ng)		
	Semester	•	First year M. Tec	h., Sem. I			
	e Code		5ST560				
	e Name		Research Method	lology (PC)			
Desire	ed Requis	ites:	NA				
		~ -			~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	- .	
	Teaching	s Scheme	T 1	1	on Scheme (Mar		
Lectur		-	T1	T2	ESE	Tot	
Tutor		-	20	20	60	10	0
Practi Intera		- 2 Hrs/Week			7		
Intera	cuon	2 Hrs/ week			Credits: 2		
			Course	Objectives			
	To prep	are students for	undergoing researc		d formulate the r	esearch prob	lems state
1			esearch layout, set				ionio, biaio
			nvestigate the pro				es, suggest
2	possible	/alternative solut	tions, solve and p	rove the solut	tion adapted-log	fically and an	nalytically,
		e the research fin					
3			analyze criticall		e and publish re	esearch in co	onferences,
	Journals	and to expose sti	udents to research				
CO1	Analyz	research and its	significance in eco	itcomes (CO)	and legal aspects		
CO1	1		ns and its design for				
CO3			on, publication, Dis			19.	
			, F,	~	F		
Modu	ıle		Module	e Contents			Hours
	Eng	ineering Researc	ch process				
		0	h problem, Sour		I .		
Ι			good research p				7
		problem, Definition, scope and objectives of research problem. Approaches of investigation of solutions for research problems, data collection, analysis,					
			ary instrumentatio		uata collection	i, analysis,	
		earch methodolo					
			0.	resources ide	entification for	solution,	
II	Expe		nalytical modellin		and Statistical		7
			Software tools like	e spreadsheets	, Effective litera	ture studies	
		oaches, critical a					
		ctive Technical		(Care has t		7
III	-		ethics, Effective		ting, how to wi	rite reports,	7
		nts and IPR	f paper/report/semi				
			Property: Patents,	Designs. Trad	le and Copvright	. Process of	
			elopment: techno				
IV		•	national Scenario:	•			7
			for grants of pate				1
			ts. Licensing and t				
			on of Patent Sys				
	Biol	ogical Systems, C	Computer Software	etc. Tradition	ai knowledge Ca	se Studies	

	Text Books
1	Melville Stuart and Goddard Wayne, "Research Methodology: An Introduction for Science &
	Engineering Students" Juta and Company Ltd, 2000.
2	Goddard Wayne and Melville Stuart, "Research Methodology: An Introduction", Juta and
	Company Ltd., 2 nd Ed2004
3	Merges Robert, Menell Peter, Lemley Mark, "Intellectual Property in New Technological
	Age", ASPEN Publishers, 2016.
4	Kumar Ranjit, "Research Methodology: A Step by Step Guide for beginners", SAGE
	Publications, 4 th Ed2014.
	References
1	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
2	Mayall, "Industrial Design", McGraw Hill, 1992.
3	Niebel, "Product Design", McGraw Hill, 1974
4	Asimov, "Introduction to Design", Prentice Hall, 1962
5	Ramappa T., "Intellectual Property Rights Under WTO", S. Chand, 2008
	Useful Links
1	NPTEL :: General - NOC:Introduction to Research
2	Introduction to Research - Course (nptel.ac.in)
3	Qualitative Research Methods And Research Writing - Course (nptel.ac.in)

			СО-РО Марр	oing		
			Programme (Dutcomes (PO)		
	1	2	3	4	5	6
CO1	3					
CO2		2		3	2	
CO3		3		2		

Assessment

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	T1	T2	ESE	Total
Remember				
Understand				
Apply	10	10	10	30
Analyze	5	10	15	30
Evaluate	5		15	20
Create			20	20
Total	20	20	60	100

			,	AY 2021-22			
				rse Informatio	on		
Progra	amme			ructural Engine			
	Semester	•		. Tech., Sem. I	B)		
	e Code	•	5ST501				
	e Name			of Structures (P	C1)		
	d Requis	ites•			-	ctural Mechanics	
JUSITU	u Requis	1105.	Bond Meena	ines, Budetula		ieturar meenames	
	Teaching	Scheme		Exami	nation Schem	e (Marks)	
Lectur		3 Hrs/week	T1	T2	ESE	Total	
Futori		J III 3/ WEEK	20	20	<u> </u>	100	
Practi			20	20	00	100	
ntera		-			Credits: 3		
merd	cuon	-	<u> </u>		Creuits: J		
			Co	urse Objective			
1	Toimpo	rt the knowledge				e	
1	^	<u> </u>				5.	
2	-	ide knowledge fo		• •			
3	To prepa	are students to de	evelop comput	er programs by	using matrix	methods of structura	l analys
			0	0.4			
701	Annly	dran and mathed		se Outcomes ((0)		
$\frac{CO1}{CO2}$		dvanced method					
CO2 CO3		te forces and dis	<u>*</u>	A		for field applications	,
05	Formul	ate program by	using matrix m	iethous of struc	analysis	for field applications	
Modu	le		Ma	dule Contents	y		TT
liouu			1110				Hour
	– (a) K	asics in structu	ral analysis		9		Hours
		asics in structures				l analysis energy	Hour
	Туре	es of structures,	various load	s and methods	s of structura	l analysis, energy	Hour
I	Type theo	es of structures, rems and application	various load	s and methods	s of structura	l analysis, energy to basic software	
I	Type theo for s	es of structures, rems and applica tructural analysis	, various load ation of virtual s.	s and methods work principle	s of structura e. Introduction		Hours
Ι	Type theo for s b) In	es of structures, rems and applica tructural analysis afluence line Dia	various load ation of virtual s. agrams for In	s and methods work principle determinate S	s of structura e. Introductior tructures	to basic software	
Ι	Type theo for s b) In Cone	es of structures, rems and applica tructural analysis afluence line Dia	various load ation of virtual s. agrams for In uller-Breslau's	s and methods work principle determinate S	s of structura e. Introductior tructures		
Ι	Type theo for s b) In Cone bean	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M	various load ation of virtual s. agrams for In uller-Breslau's ninged arches.	s and methods work principle determinate S	s of structura e. Introductior tructures	to basic software	
I	Type theo for s b) In Cone beam Beam	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ns. ILD for two h ms Curved in P	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan	s and methods work principle determinate S s principle and	s of structura e. Introductior tructures l its application	to basic software	
	Type theo for s b) In Con- bean Bean Strue bean	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M os. ILD for two h ms Curved in Pla ctural behaviour os curved in plan	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams.	s and methods work principle determinate S s principle and	s of structura e. Introductior tructures 1 its application	n to basic software	7
II	Type theo for s b) In Con- bean Bean Strue bean Bean	es of structures, rems and applica tructural analysis ofluence line Dia cept of ILD, M ns. ILD for two h ns Curved in Pla ctural behaviour ns curved in plan ms on Elastic Fo	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. pundations	s and methods work principle determinate S s principle and am. Analysis o	s of structura e. Introduction tructures l its application f determinate	n to basic software on for continuous and indeterminate	7 7
	Type theo for s b) In Con- bean Bean Strue bean Bean Basi	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Ple ctural behaviour ms curved in plan ms on Elastic Fo c concept of bea	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. pundations	s and methods work principle determinate S s principle and am. Analysis o	s of structura e. Introduction tructures l its application f determinate	n to basic software	7
II	Type theo for s b) In Com bean Bean Strue bean Basi and	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pla ctural behaviour ns curved in plan ms on Elastic Fo c concept of bea finite beams.	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. pundations	s and methods work principle determinate S s principle and am. Analysis o	s of structura e. Introduction tructures l its application f determinate	n to basic software on for continuous and indeterminate	7 7
II	Type theo for s b) In Cone bean Bean Strue bean Basi and Basi	es of structures, rems and applica tructural analysis offuence line Dia cept of ILD, M ns. ILD for two h ms Curved in Pl ctural behaviour ns curved in plan ms on Elastic Fo c concept of bea finite beams. m Columns	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. pundations ams on elastic	s and methods work principle determinate S s principle and am. Analysis o e foundation, a	s of structura e. Introduction tructures l its application f determinate nalysis of inf	n to basic software on for continuous and indeterminate inite, semi-infinite	7 7
Ш	Type theo for s b) In Con- bean Strue bean Basi and Basi and	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pla ctural behaviour ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material	s and methods work principle determinate S s principle and am. Analysis o c foundation, a nonlinearity, g	s of structura e. Introduction tructures l its application f determinate nalysis of info governing diff	n to basic software on for continuous and indeterminate inite, semi-infinite erential equations.	7 7 6
II	Type theo for s b) In Con- bean Strue bean Basi and Basi and Con- Ana	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pl ctural behaviour ns curved in plan ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-co	, various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjected	s and methods work principle determinate S s principle and am. Analysis o e foundation, a nonlinearity, g ed to different	s of structura e. Introduction tructures l its application f determinate nalysis of infi- governing diff loadings and s	and indeterminate inite, semi-infinite erential equations. upport conditions.	7 7
Ш	Type theo for s b) In Com bean Bean Strue bean Basi and Basi and Com Ana Buc	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pla ctural behaviour ns on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-co cling of frames	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjecte -symmetrical	s and methods work principle determinate S s principle and um. Analysis o e foundation, a nonlinearity, g ed to different and unsymme	s of structura e. Introduction tructures l its applicati f determinate nalysis of infi governing diff loadings and s etrical, stiffne	and indeterminate and indeterminate inite, semi-infinite erential equations. upport conditions. ss and carry-over	7 7 6
Ш	Type theo for s b) In Come beam Bean Strue beam Basi and Basi and Come Ana Bucl facto	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pla ctural behaviour ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-co cling of frames ors for beam-colu	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjecte -symmetrical umns, fixed en	s and methods work principle determinate S s principle and am. Analysis o c foundation, a nonlinearity, g ed to different and unsymme d actions due to	s of structura e. Introduction tructures l its applicati f determinate nalysis of infi governing diff loadings and s etrical, stiffne	and indeterminate and indeterminate inite, semi-infinite erential equations. upport conditions. ss and carry-over	7 7 6
II III IV	Type theo for s b) In Con- bean Strue bean Basi and Basi and Basi and Con- Ana Bucl facto	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pla ctural behaviour ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-co kling of frames ors for beam-colu rix method of a	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjected symmetrical umns, fixed en- nalysis: Flexil	s and methods work principle determinate S s principle and am. Analysis o e foundation, a nonlinearity, g ed to different and unsymme d actions due to bility Method	s of structura e. Introduction tructures l its application f determinate nalysis of infi- governing diff loadings and setrical, stiffne	and indeterminate and indeterminate inite, semi-infinite erential equations. upport conditions. ss and carry-over s.	7 7 6
Ш	Type theo for s b) In Cond bean Strue bean Basi and Basi and Basi and Cond Ana Bucl facto Mat Elen	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pl ctural behaviour ns curved in plan ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-co cling of frames ors for beam-colu rix method of a nent approach, for	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjecte -symmetrical umns, fixed en nalysis: Flexil flexibility mat	s and methods work principle determinate S s principle and am. Analysis o e foundation, a nonlinearity, g ed to different and unsymmed d actions due to bility Method trix, equivalen	s of structura e. Introduction tructures l its application f determinate nalysis of infi- governing diff loadings and setrical, stiffne o various loads t loads, appli	and indeterminate and indeterminate inite, semi-infinite erential equations. upport conditions. ss and carry-over	7 7 6
II III IV	Type theo for s b) In Com bean Bean Strue bean Basi and Bean Basi and Com Ana Bucl facto Mat Elen fram	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Plactural behaviour ns curved in plan ms on Elastic For c concept of bea finite beams. m Columns cept of geometri lysis of beam-colu cling of frames ors for beam-colu rix method of a nent approach, for es and trusses, la	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjecte -symmetrical umns, fixed en nalysis: Flexil flexibility mat ack of fit, temp	s and methods work principle determinate S s principle and am. Analysis o e foundation, a nonlinearity, g ed to different and unsymme d actions due to bility Method trix, equivalen perature stresse	s of structura e. Introduction tructures l its application f determinate nalysis of infi- governing diff loadings and setrical, stiffne o various loads t loads, appli	and indeterminate and indeterminate inite, semi-infinite erential equations. upport conditions. ss and carry-over s.	7 7 6 6
II III IV V	Type theo for s b) In Com bean Bean Strue bean Basi and Basi and Com Ana Bucl facto Elen fram	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pl ctural behaviour ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-colu- ris method of a nent approach, for es and trusses, la rix method of a	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjecte -symmetrical umns, fixed en nalysis: Flexil flexibility mat ack of fit, temp nalysis: Stiffn	s and methods work principle determinate S s principle and am. Analysis o c foundation, a nonlinearity, g ed to different and unsymme d actions due to bility Method trix, equivalen perature stresse tess Methods	s of structura e. Introduction tructures l its application f determinate nalysis of infi- governing diff loadings and set rical, stiffne o various loads t loads, appli s.	and indeterminate and indeterminate inite, semi-infinite erential equations. ss and carry-over s. cations to beams,	7 7 6 6
II III IV	Type theo for s b) In Cone bean Strue bean Basi and Basi and Basi and Bucl facto Mat Elen fram	es of structures, rems and applica tructural analysis offluence line Dia cept of ILD, M ms. ILD for two h ms Curved in Pl ctural behaviour ms on Elastic Fo c concept of bea finite beams. m Columns cept of geometri lysis of beam-colu- ris method of a nent approach, for es and trusses, la rix method of a	various load ation of virtual s. agrams for In uller-Breslau's ninged arches. lan of curved bea n, bent beams. oundations ams on elastic c and material lumns subjecte -symmetrical umns, fixed em nalysis: Flexil flexibility mat ack of fit, temp nalysis: Stiffn stiffness matr	s and methods work principle determinate S s principle and am. Analysis o e foundation, a nonlinearity, g ed to different and unsymme d actions due to bility Method trix, equivalent sess Methods ix, equivalent	s of structura e. Introduction tructures l its application f determinate nalysis of infi- governing diff loadings and set rical, stiffne o various loads t loads, appli s.	and indeterminate and indeterminate inite, semi-infinite erential equations. upport conditions. ss and carry-over s.	7 7 6

1	Vazirani. V.N. & Ratwani M.M., "Advanced Theory of Structures", Khanna Publishers, 2008
2	Timoshenko. S. P. & Gere. J. M., "Theory of Elastic Stability", Tata McGraw-Hill Publishing
Z	company Ltd., 2 nd Edition,1985
3	Gere. J. M. & Weaver. W.,"Matrix Analysis of Framed Structures", CBS Publishers and
5	Distributor, 2 nd Edition,2004.
4	Krishna Raju N., "Advanced Mechanics of Solids and Structures", McGraw-Hill
	Education, 08-Nov-2018 - Technology & Engineering
	References
1	Mcquire and Gallghar. R. H. "Matrix Structural Analysis", John Wiley, 2 nd Edition, 2000
2	Beaufit F.W et al. "Computer Methods of Structural Analysis", Prentice Hall, illustrated, 1970
3	John L. and Meek, "Matrix Structural Analysis", McGraw Hill Book Company,
5	illustrated,1971
4	Pandit G. and Gupta S., "Structural Analysis - A Matrix Approach2008", McGraw Hill
т	Education; 1st edition
	Useful Links
1	https://nptel.ac.in/courses/105/105/105105108/
2	https://nptel.ac.in/courses/105/101/105101086/
3	http://engineeringvideolectures.com/course/281?pn=0#videolist
4	https://nptel.ac.in/courses/105/105/105105109/

			CO-PO Mapp	oing		
			Programme O	outcomes (PO)		
	1	2	3	4	5	6
CO1			2	2		3
CO2			2	2		3
CO3	1		2			2

Assessment

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	T1	T2	ESE	Total
Remember				
Understand				
Apply	10	10	10	30
Analyze	5	10	15	30
Evaluate	5		15	20
Create			20	20
Total	20	20	60	100

		Walc	hand Colle	ge of Engi	neering, Sang	gli	
			(Government A	Aided Autonom	ous Institute)		
				AY 2021-22			
			Cou	rse Informat	ion		
Progr	amm	ie	M.Tech. (Str	ructural Engin	eering)		
Class,	Sem	lester	First year M	. Tech., Sem.	I		
Cours	se Co	de	5ST502				
Cours	e Na	me	Theory of El	asticity and P	lasticity (PC 2)		
Desire	ed Re	equisites:	Solid Mecha	nics			
	Теа	ching Scheme		Fyam	ination Scheme (Marks)	
Lectu		3 Hrs/week	T1	T2	ESE	Total	
Tutor		-	20	20	60 ESE	100	
Practi			20	20	00	100	
Intera		<u> </u>			Credits: 3		
		-					
			Cor	urse Objectiv	7es		
1		impart knowledge of ar problems.	various theor	ies of elastici	ty and apply then	n to solve 2D Car	tesian and
2		impart knowledge of blems.	various theorie	es of torsion a	nd apply them to	solve 2D torsiona	1
3		provide knowledge o blems.	f various theor	ies of plastic l	behavior and appl	y them to solve 21	C
	<u> </u>		Cours	e Outcomes	(CO)		
CO1	Ap	ply the knowledge of	fundamental r	nethods of ela	sticity for 2-D Ca	rtesian and Polar	problems.
CO2	An	alyze torsional proble	ems and appris	e various theo	pries to solve 2-D	torsional problem	s.
CO3	Dis	cuss concept of mate	rial yielding ar	nd plastic beha	avior of structures		
Modu	ıle		Ma	dule Content	te		Hours
mouu		Introduction to Elas					muis
Ι		Introduction to Elast Strain, Transformat dimensions in Carte relations, Compatibil	icity: Body fo ion of stress sian coordinat	, Equilibrium es, Boundary	n equations in conditions, Strai	two and three in displacement	8

Π	Plane Stress and Strain	8
11	2D problems in Cartesian coordinates, Equations of equilibrium and compatibility, Plane stress and Plane strain problems, Airy stress function approach, 2D problems in polar coordinates, Thick walled cylinder under radial pressure, Plate with stress concentration.	
	Torsion	
III	Introduction to Torsion: St. Venant's theory, Warping function, Prandtl's membrane analogy, Torsion of circular, thin rectangular and open sections. Strain energy in axial, bending and torsion. Principle of virtual work and minimum potential energy.	7
	Plasticity	
IV	Introduction to plasticity: Plastic behavior of solids, Idealized plastic solids, Similarities& differences when compared with elasticity, Idealized material behavior, Coulomb friction model for elasticity and plasticity.	8
	Hydrostatic Stresses	
V	Hydrostatic stresses, Deviatoric stresses, Invariants of deviatoric stresses, Yield criteria, Graphical representation of yield criteria, Flow rules, Stress-strain relation for perfectly plastic flow, Elastic-plastic analysis of beam in bending, Thick walled cylinder and circular shaft under torsion.	7
	Plastic analysis of structures	
VI	Plastic analysis of structures – plastic hinge, Moment – curvature relation, Shape factor, Upper bound, lower bound and uniqueness theorems, Methods of analysis to find collapse loads for beams and frames.	7
	Textbooks	
1	Ameen M., "Computational Elasticity", Alpha Science International, 1 st Revised 2008.	d Edition
2	Singh Sadhu, "Theory of Elasticity", Khanna Publishers, 4th Edition, 2012.	
3	Singh Sadhu, "Theory of Plasticity", Khanna Publishers, 3 rd Edition, 2013	
	References	
1	Timoshenko. S & Goodier. J. N., "Theory of Elasticity", McGraw-Hill book Cor Edition, 2010.	npany, 3 ¹
2	Chakrabarthy. J, "Theory of Plasticity", Tata McGraw-Hill P. Co. Ltd., 2nd Edition,	2007.
3	Johnson W. and Mellor P. B., "Engineering Plasticity", Van Nostrand Reinhold, Lon	don, 197.
	Useful Links	
1	https://nptel.ac.in/courses/105/105/105105177/	

2]	https://nptel.ac.in/courses/105/105/105105108/
3.	1	https://nptel.ac.in/courses/105/102/105102090/
4.	1	https://onlinecourses.nptel.ac.in/noc21_ce45/preview

<u>CO1</u>	1	2	3	4	_	
<u>CO1</u>			5	4	5	6
CO1	1		3	2		2
CO2	1			3		2
CO3	1			3		2

Assessment

Assessment Plan based on Bloom's Taxonomy Level						
Bloom's Taxonomy Level	T1	T2	ESE	Total		
Remember						
Understand						
Apply	10	10	10	30		
Analyze	5	10	15	30		
Evaluate	5		15	20		
Create			20	20		
Total	20	20	60	100		

		Walc	hand Colle	ge of Engi	neering, Sang	gli		
			(Government A	Aided Autonome	ous Institute)			
			,	AY 2021-22				
			Cou	rse Informati	on			
Progra	amme		M.Tech. (Str	uctural Engine	eering)			
Class,	Semester		First year M.	Tech., Sem. I				
Cours	e Code		5ST511					
Cours	e Name		Structural Dy	ynamics and E	arthquake Engine	eering (PE1)		
Desire	ed Requisi	ites:	Engineering	Mechanics, E	ngineering Geolog	ду		
	Teaching	Scheme		Exami	nation Scheme (Marks)		
Lectu	re	3 Hrs/week	T1	T2	ESE	Total		
Tutor	ial	-	20	20	60	100		
Practi	cal	-			· · ·			
Intera	ction	-	Credits: 3					
			Cou	irse Objectiv	es			
1	To impa structure	-	of ground mo	tion character	ristics and its ef	fect on Civil E	ngineering	
2	To prepa	re students to se	olve problems of	on dynamics o	f structures in SD	OF and MDOF S	ystems	
3		rate national and intation of same			design of earthqu	ake resistant struc	ctures and	
	1		Cours	e Outcomes (CO)			
CO1	Use engi	ineering seismo	logy and its cha	aracteristics fo	r development of	response spectra.		
CO2	Estimat	e response of st	ructures subject	ted to earthqua	ke loads for varie	ous building confi	gurations.	
CO3	Evaluat	e forces for desi	gn of earthqual	ke resistant str	ucture.			
Modu	ıle		Mo	dule Content	5		Hours	
	Seisn	nological Aspe	ct in Earthqua	ke Engineeri	ng			
Ι	Char earth	acteristics of quakes, Magn	Earthquakes, iitude, Intensi	Seismological Aspect in Earthquake EngineeringCharacteristics of Earthquakes, Elastic rebound theory, Measurement of earthquakes, Magnitude, Intensity, magnitude relationship, Seismograph, Liquefaction. Attenuation relationship, MCE and DBE, Performance of various6				

structures in past earthquakes.

SDOF Systems and Estimation of Foress			
analysis. Concept of earthquake response spectrum, Tripartite plot of response spectrum, Construction of design response spectrum. Use of Code Spectra to find response of structures. Equivalent static method to find story shear and its distribution along height of building.			
MDOF Systems and Dynamic Analysis			
Earthquake response of linear MDOF systems, Modal analysis, Participation factors, Modal contributions, Dynamic analysis of Multistoried buildings.			
ERD of Structure and Role of Ductility			
Concept of earthquake resistant design, Objectives, Ductility and different types of ductility. Over strength, Response reduction factor, Ductile Detailing of structural components as per code. lateral stiffness, Conceptual design, Building configuration.	7		
Distribution of Lateral Forces and Codal Provisions			
Floor diaphragm, Rigid floor diaphragm, Center of mass and center of stiffness, Torsionally uncoupled and coupled systems, Lateral load distribution, Minimum eccentricity, Provisions of IS: 1893 for buildings, Base shear, Application to Multistory buildings, Load combinations, Ductile detailing, Provisions of IS: 13920.			
Structural Control and Retrofit Issues			
Different lateral load resisting systems, Configuration of tall structures with modeling. Nonlinear analysis of structures. Concepts of structural Control, Energy dissipating devices. Retrofit issues and their solutions with advanced techniques.			
Toxt Dooks			
Clough R. W. andPenziene Joseph, " <i>Dynamics of Structures</i> ', McGraw Hill Educ Editions); International 2 Revised edition August 1993.	ation (ISE		
Chopra A.K., "Dynamics of Structure: Theory & Application to Earthquake Eng Pearson Education Lim., 4th Edition, 2014	ineering",		
 Pearson Education Lim., 4th Edition, 2014 Agarwal P. and Shrikhande M., "Earthquake Resistant Design of Structures", PHI Pvt. Ltd., 2006. 			
Pearson Education Lim., 4th Edition, 2014 Agarwal P. and Shrikhande M., " <i>Earthquake Resistant Design of Structures</i> ", PHI Pvt. Ltd., 2006. References	[Learning		
 Pearson Education Lim., 4th Edition, 2014 Agarwal P. and Shrikhande M., "Earthquake Resistant Design of Structures", PHI Pvt. Ltd., 2006. 	[Learning		
Pearson Education Lim., 4th Edition, 2014 Agarwal P. and Shrikhande M., "Earthquake Resistant Design of Structures", PHD Pvt. Ltd., 2006. References Key David, "Earthquake Design Practice for Buildings", Thomas Telford P	Learning		
	 spectrum, Construction of design response spectrum. Use of Code Spectra to find response of structures. Equivalent static method to find story shear and its distribution along height of building. MDOF Systems and Dynamic Analysis Earthquake response of linear MDOF systems, Modal analysis, Participation factors, Modal contributions, Dynamic analysis of Multistoried buildings. ERD of Structure and Role of Ductility Concept of earthquake resistant design, Objectives, Ductility and different types of ductility. Over strength, Response reduction factor, Ductile Detailing of structural components as per code. lateral stiffness, Conceptual design, Building configuration. Distribution of Lateral Forces and Codal Provisions Floor diaphragm, Rigid floor diaphragm, Center of mass and center of stiffness, Torsionally uncoupled and coupled systems, Lateral load distribution, Minimum eccentricity, Provisions of IS: 1893 for buildings, Base shear, Application to Multistory buildings, Load combinations, Ductile detailing, Provisions of IS: 13920. Structural Control and Retrofit Issues Different lateral load resisting systems, Configuration of tall structures with modeling. Nonlinear analysis of structures. Concepts of structural Control, Energy dissipating devices. Retrofit issues and their solutions with advanced techniques. Clough R. W. andPenziene Joseph, "Dynamics of Structures' ', McGraw Hill Educ Editions); International 2 Revised edition August 1993. 		

	2000.
	Useful Links
1	https://nptel.ac.in/courses/105/101/105101209/
2	https://nptel.ac.in/courses/105/104/105104200/
3	https://nptel.ac.in/courses/105/108/105108204/
4	https://nptel.ac.in/courses/105/107/105107204/

	CO-PO Mapping								
	Programme Outcomes (PO)								
	1	2	3	4	5	6			
CO1	1		3	2		2			
CO2		2				2			
CO3			2	2	2	3			

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High.

Each CO of the course must map to at least one PO.

Assessment

Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	T1	T2	ESE	Total			
Remember							
Understand							
Apply	10	10	10	30			
Analyze	5	10	15	30			
Evaluate	5		15	20			
Create			20	20			
Total	20	20	60	100			

V	Valchand College of Engineering, Sangli
	(Government Aided Autonomous Institute)
	AY 2021-22
	Course Information
Programme	M.Tech. (Structural Engineering)
Class, Semester	First year M. Tech., Sem. I
Course Code	5ST512
Course Name	Advanced Design of Steel Structures (PE1)
Desired Requisites:	Design of Steel Structures

Teaching Scheme		Examination Scheme (Marks)				
Lecture	3 Hrs/week	T1	T2	ESE	Total	
Tutorial	-	20	20	60	100	
Practical	-					
Interaction	-	Credits: 3				
	1					

	Course Objectives
1	To provide the knowledge of design of steel structures such as bridges, multistory buildings and portal frames.
2	To impart the knowledge of cold formed sections and composite beams.
3	To illustrate plastic analysis and design of steel frames.
	Course Outcomes (CO)
CO1	To provide the knowledge of design of steel structures such as bridges, multistory buildings and portal frames.
CO2	To impart the knowledge of cold formed sections and composite beams.
CO3	To illustrate plastic analysis and design of steel frames.

Module	Module Contents	Hours
Ι	Foot Bridges Analysis and design of footbridges, Deck of through type bridges, Flooring system, Bracing system.	7
Π	Cold Formed Sections Cold formed light gauge steel sections, Various profiles, Stiffened and unstiffened sections, Roof sheeting, Purlins, Flexure and column behavior, IS code provisions.	6
III	Composite Sections Composite section consisting of structural steel and concrete, Composite beams, Shear connectors, Composite decks using light gauge steel and concrete, Composite columns, IS code provisions.	7
IV	Introduction to Plastic Analysis Introduction to Plastic Analysis, Plastic bending of beam, Plastic hinge, Shape factor of cross section, Static and kinematic methods of analysis, Plastic analysis and design of propped cantilever, fixed beam and continuous beams.	6
V	Multistorey Buildings Multistory buildings, Lateral load resisting systems, Types of bracing systems, Shear wall, Inelastic analysis of multistory, multi-bay frames.	8
VI	Low Rise Portal Frames Analysis of low rise rectangular and gable portal frames, Various basic mechanisms, Combination of mechanisms, Limit state design of frames, Haunches and column bases.	7

	Text Books
1	Vazirani V. N., and Ratwani M. M., "Steel Structures and Timber Structures", Khanna
1	Publishers, Delhi.
2	Ramchandran, "Design of Steel Structures – Vol. II", Standard Book House, Delhi.
3	Punmia B. C., Jain A. K. and Jain A. K. "Design of Steel Structures", Firewell Media.
	References
1	Taranath B. S., "Structural Analysis and Design of Tall Buildings", McGrawhill.
2	Bekar J. F., Horne M. R., Heyman J., "Steel Skeleton Vol. II Plastic Behavior& Design"
Ζ	ELBS
3	Neal B. G., "Plastic Methods of Structural Analysis", Chapter & Hall.
	Useful Links
1	https://nptel.ac.in/courses/105/105/105162/
2	https://nptel.ac.in/courses/105/106/105106112/
3	https://nptel.ac.in/courses/105/106/105106113/

			CO-PO Mapp	oing					
	Programme Outcomes (PO)								
	1	2	3	4	5	6			
CO1	1		2	3					
CO2	1		2	3					
CO3				3	2	2			

Assessment

Assessment Plan based on Bloom's Taxonomy Level						
Bloom's Taxonomy Level	T1	T2	ESE	Total		
Remember						
Understand	5		5	10		
Apply	10	15	5	40		
Analyze		15	10	35		
Evaluate				10		
Create				5		
Total	10	30	10	100		

				Aided Autonome AY 2021-22			
				irse Informati	ion		
Progra	amme		M.Tech. (Ci	vil - Structural	Engineering)		
	Semester	•		I. Tech., Sem.			
	e Code		5ST513	, ~~			
	e Name			esign of Reinf	orced Concret	e Structures (PE2)	
	d Requis	ites·				of Concrete Structure	-s II
	u nequis		Design of ex		les i, Design (25 H
	Teaching	Scheme		Exami	ination Schem	ne (Marks)	
Lectu		3 Hrs/week	T1	T2	ESE	Total	
Futori			20	20	60	100	
Practi		-	20	20	00	100	
Intera		-			Credits: 3	2	
mera	cuon	-			Creans. S	•	
			Ca	urse Objectiv	05		
1	Toprovi	de advanced les		•		Cetructures	
$\frac{1}{2}$		de advanced kno				structures.	odes
3						bers designed as per	
5	10 piovi		<u> </u>	se Outcomes (ibers designed as per	15 00003
CO1	Analyze	various reinfor					
CO2		structural details			S.		
CO3		he appropriate s				provisions.	
000	2 00-8-1						
Modu	le		Mo	dule Contents	S		Hours
		Slabs and Circ					
Ι				al provisions,	Analysis and	d design of flat	7
		Circular slabs.	-		2	C	
	Desi	gn of Concrete	Deep Beams				
II	Intro	duction, Minim	um thickness,	IS code requir	rements, Desig	gn of deep beams,	6
	Chec	king for local fa	ilures, Detaili	ng, Design of (Corbel.		
		stribution of m					
		,			,	ode conditions for	
III						ges of moment	6
						noments in beams,	
		nation of crack v	width in reinfo	rcea concrete i	members.		
117		er Tank	of or other of	watan tanla Da	otonoular and	Circular with flat	7
IV					-	Circular with flat	7
	1	om, Design of sta ining Wall	aging for wind		Jaus.		
			Function The	ories of earth	pressure Stal	oility of retaining	
V		0			•	wall, Counterfort	7
		ning wall.	intere returning		e er retunning		'
	1	kers and Silos					
1 7 1			 Classification 	on, Square bu	nkers, Circula	ar bunkers, Silos,	
VI				-		eep bins, Design	6
		nples.	· · ·	• ·			
						·	
				Textbooks			
1		amruthm, S., "I on, 2010.	Design of Reir		ete Structures"	, Dhanpat Rai Publi	shing, 1

	Publications, 4 th Edition, 2003.
3	Punmia, B. C., Jain, A. K. and Jain, A. K. "Limit State Design of Reinforced Concrete", Laxmi Publication, 1 st Edition, 2013.
4	
	References
1	Purushothaman, P. "Reinforced Concrete Structural Elements", Tata McGraw Hill, 3 rd Edition, 2004.
2	Pillai. S. V. and Menon. D, "Reinforced Concrete Design", Tata McGraw Hill Book Co., 5 th Edition, 2005.
3	Park. R and Paulay. T, "Reinforced Concrete Structures", John Wiley and Sons, 1975.
4	IS 456: 2000 Indian Standard Plain and Reinforced Concrete - Code of Practice
	Useful Links
1	Advanced Concrete Design by Prof Devdas Menon Lecture 1 - YouTube
2	NPTEL :: Civil Engineering - Design of Reinforced Concrete Structures
3	Design Of Reinforced Concrete Structures - Course (nptel.ac.in)

	Programme Outcomes (PO)								
	1	2	3	4	5	6			
CO1	1		3	2		2			
CO2		2				2			
CO3			2	2	2	3			

Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	T1	T2	ESE	Total			
Remember							
Understand							
Apply							
Analyze	5	5	15	35			
Evaluate	10	10	5	40			
Create	5	5	10	25			
Total	20	20	60	100			

		Walc		ege of Engi Aided Autonome		ngli		
			1	AY 2021-22				
			1	rse Informati				
Progra				ructural Engine				
-	Semester		-	. Tech., Sem. I	[
	e Code		5ST514					
	Course Name		-	Computer Aided Analysis and Design (PE2)				
Desire	ed Requisites	:	Dynamics of	f Concrete Stru	ictures, Desigr	of Steel Structures		
	Teaching Sc	heme		Exami	nation Schem	e (Marks)		
Lectur		Hrs/week	T1	T2	ESE	Total		
Tutori		-	20	20	60	100		
Practi	cal	-		1	1	I		
Intera		-			Credits: 2			
			1					
			Cor	urse Objectiv	es			
1	To provide	knowledge o		•		nalysis by computers		
	-			<u> </u>		lyzing and solving p		
2	the field of	•	C a		•			
-		<u> </u>	e knowledge t	to the students	s for analyzin	g and designing stru	uctures by	
3	professional		8-			5		
			Cours	se Outcomes (CO)			
CO1			for modeling					
CO2	•		d Steel structu					
CO3	Create vari	ous program	s for the design	n of structures.				
N	1.		M				TT	
Modu		m Dovolon		dule Content gramming La			Hours	
						orithm essentials.		
_		Basics of computer hardware and os, WWW and Apps, Algorithm essentials: problem analysis and flowcharting, fundamentals of sequential programming:						
Ι		Variables, data types & functions + input-output + data handling + various						
		opment units, Introduction to programming in MS EXCEL®, MATLAB®,						
	PYTHO					. 7		
	Matrix	Methods an	d Programmi	ng				
II		-	-			equations, Eigen	5	
				amming techni	ques of above	methods.		
			and Program	0				
III						thods, Regression	5	
						ructural dynamics.		
				s of above met	nods.			
			ructural Anal		veis of CP have	Stiffness method,		
IV						rithm development	5	
		structural an		. Je marysi	5 155 405 . 7 11501	ium development		
	Combu			gn				
X 7		ter Aided St	ructural Desig		sign of Beam	sections in RCC,		
V	Design	t er Aided St of Steel Tru	ructural Desig ss members b	y IS-800, De		sections in RCC, n development for	5	
V	Design Design	t er Aided St of Steel Tru	ructural Designs members b and Two-way	y IS-800, De			5	
	Design Design each stru Comme	ter Aided St of Steel Tru of One way actural design rcial Softwa	ructural Designs members but and Two-wayn type.	by IS-800, Dea slabs by IS-4 ns	456. Algorithm	n development for	5	
V VI	Design Design each stru Comme Applicat	ter Aided St of Steel Tru of One way actural design rcial Softwa ion in com	ructural Designs members by and Two-wayn type. Tre Application mercial softw	by IS-800, Des slabs by IS-4 ns vare SAP [®] /AE	456. Algorithm BACUS [®] /ANS		5	

	COMBINAIONS. Design of building members- Beam, Slab, Column, Footing by
	STAAD [®] , Introduction to other commercial soft-wares.
	Textbooks
1	Pratap Rudra,"Getting started with MATLABTM", Oxford University press, 2010.
2	Jain M. K., Iyengar S. R. K. & Jain R. K. " Numerical Methods for Scientific and Engineering
2	Computation ", 4th ed. 2004.
3	Pundit & Gupta "Structural Analysis", Tata MC Graw Hill Book company.
	References
1	Steve Otto and James P. Denier "An Introduction to Programming and Numerical Methods"
1	in, Springer International books, 1st Edition, 2007
2	Cotes, R.C., Couties, M.G., and Kong, F.K., Structural Analysis, ELBS.
3	Chopra A. K., "Structural Dynamics for Earthquake Engineering", Pearson Publications.
	Useful Links
1	https://nptel.ac.in/courses/105/105/105105180/
2	http://www.nptelvideos.in/2012/11/numerical-methods-in-civil-engineering.html
3	https://in.mathworks.com/matlab/trial
4	http://www.gnumeric.org/freewarespreadsheetshttps://d.wps.com/?from=premiumpage#/

			СО-РО Марр	ping			
Programme Outcomes (PO)							
	1	2	3	4	5	6	
CO1	1		3	2		2	
CO2				2		2	
CO3	1		2	2	2	3	

Assessment

Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	T1	T2	ESE	Total			
Remember							
Understand							
Apply	10	10	10	30			
Analyze	5	10	15	30			
Evaluate	5		15	20			
Create			20	20			
Total	20	20	60	100			

			(Government A	Y 2021-22			
				se Informati)n		
Progra	mme		M. Tech. (Str				
	Semester		First year M.				
Course			5ST553	,			
Course	Name		Presentation a	and Technical	Report Writing		
r	Feaching	Scheme		Exami	nation Scheme (M	larks)	
Lectur	e	-	LA1	LA2	ESE	Total	
Tutori	al	-	30	30	40	100	
Practio	al	-					
Intera	ction	1 Hr/Week			Credits: 1		
1	Produce	effective dialog		rse Objective			
		<u> </u>			r communication p	urposes and atte	empt task
2		functional gram	-	-	-	r	re tubr
	,			<u> </u>	<i>.</i>		
				e Outcomes (
CO1					mmunication skills		
CO2		•			ructured conversat	ions	
CO3	Apprecia	te, analyze, eval	uate business r	eports and res	earch papers		
Modu	e		Mod	lule Contents	1		Hours
		ing the Feature					
Ι	Princi	iples and Strateg	gies of Technica	al Report, Kno	owing Your Audier	nce, Purpose	1
		ength of Report					
		atting Technic					2
II	-		ons, Running	ns, Running headers and footers, Types of reports and			
		ates to use, o the Point					
III			n Idea and an	anging detail	s in logical seque	ence. Writing	2
		& techniques, r			iogreai bequi		-
		mportance of A					
IV	Foour	on audience's	needs Deter w	ord choice to	ne, and amount of o	letails	3
1 V	to inc					iviallo	5
V	-	of Writing	mood and more	agrapha Dam	NOVO Jongon D-J	undonay and	3
v	Writh		nees and par	agraphs, ken	nove Jargon, Red	unuancy and	3
		ntation skill					
			sentation Kind	s of graphics	and their message	es, Suitability	
VI	for pl	acement in a gra	aphic represent	ation, Group	Practice and Intera	ctive Session,	3
V I					d confusing senter		3
				ntent, Logic	and Language, G	uided writing	
	practi	ce with example	es				
				Textbooks			
1				etters, Emails	s and Other Busin	ess Documents	" (seven
	1 - 1141 -	n), Prentice Hal	1				

2	Thomas Huckin, Leslie Olsen "Technical writing and Professional Communications for Non- native speakers of English", McGraw Hill
	References
1	Raman Sharma, "Technical Communication", Oxford University Press
2	Raymond Murphy "Essential English Grammar" (Elementary & Intermediate) Cambridge
2	University Press
3	Mark Hancock "English Pronunciation in Use" Cambridge University Press
	Useful Links
1	NPTEL :: Humanities and Social Sciences - NOC: Interpersonal Skills
2	Mod-10 Lec-01 Oral Presentation Lecture-01 - YouTube

	CO-PO Mapping Programme Outcomes (PO)								
	1	2	3	4	5	6			
CO1	3				2				
CO2				2	2				
CO3		3		2					

	Assessment						
There are thr	There are three components of lab assessment, LA1, LA2 and Lab ESE.						
IMP: Lab ES	E is a separate head	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.			
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks			
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30			
	attendance,	Faculty	Marks Submission at the end of Week				
	journal		6				
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30			
		Faculty	Marks Submission at the end of Week				
			12				
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40			
	journal	Faculty	Marks Submission at the end of Week				
			18				
Week 1 indic	cates starting week	of a semester. The	e typical schedule of lab assessments is sho	own,			
considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab							
activities/Lab	b performance sh	all include perf	forming experiments, mini-project, pre	esentations,			
drawings, pr	ogramming and ot	her suitable activ	ities, as per the nature and requirement	of the lab			
course. The e	experimental lab sh	all have typically	8-10 experiments.				

Assessment Plan based on Bloom's Taxonomy Level						
Bloom's Taxonomy Level	LA1	LA2	ESE	Total		
Remember						
Understand	10			10		
Apply	20	20	20	60		
Analyze		10	10	20		
Evaluate			10	10		
Create						
Total	30	30	40	100		

Walchand College of Engineering, Sangli					
	(Government Aided Autonomous Institute)				
	AY 2021-22				
Course Information					
Programme	M.Tech. (Structural Engineering)				
Class, Semester	First year M. Tech., Sem I				
Course Code	5ST551				
Course Name	Course Name Activity Based Lab - Mechanics of Structures (PC1)				
Desired Requisites:	Solid Mechanics and mechanics of structures				

Teaching Scheme		Examination Scheme (Marks)			
Lecture		LA1	LA2	ESE	Total
Tutorial	-	30	30	40	100
Practical	2 Hrs/week		·		
Interaction	-	Credits: 1			

Course Objectives							
1	To impart the knowledge of advanced methods of structural analysis.						
2	To provide knowledge for analyzing special types of structures.						
3	To prepare students to develop computer programs by using matrix methods of structural analysis.						
	Course Outcomes (CO)						
CO1	Apply advanced methods for analysis of structures.						
CO2	Calculate forces and displacements for special structures.						
CO3	Formulate program by using matrix methods of structural analysis for field applications.						

Module Contents

Students will be asked to work upon **minimum two** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

- i) Construct ILD for existing bridge structure for various structural parameters and hence analyze the variation in these structural parameters under the service load.
- ii) Analysis and design of curved beams of any existing structure. Validate the analytical results in relevant software
- iii) Develop a FEM program for the analysis of beams on elastic foundation
- iv) Analysis of multi-story 2D frames using matrix method and validation of analysis results in relevant software.

	Text Books					
1	Vazirani. V.N. & Ratwani M.M., "Advanced Theory of Structures", Khanna Publishers, 2008					
2	Timoshenko. S. P. & Gere. J. M., "Theory of Elastic Stability", Tata McGraw-Hill Publishing ompany Ltd., 2 nd Edition,1985					
3	Gere. J. M. & Weaver. W., "Matrix Analysis of Framed Structures", CBS Publishers and Distributor, 2 nd Edition, 2004.					
4	Krishna Raju N., "Advanced Mechanics of Solids and Structures", McGraw-Hill Education, 08-Nov-2018 - Technology & Engineering					
	References					
1	Mcquire and Gallghar. R. H. "Matrix Structural Analysis", John Wiley, 2 nd Edition, 2000					

2	Beaufit F.W et al. "Computer Methods of Structural Analysis", Prentice Hall, illustrated, 1970							
3	John L. and Meek, "Matrix Structural Analysis", McGraw Hill Book Company, illustrated, 1971							
4	Pandit G. and Gupta S., "Structural Analysis - A Matrix Approach2008", McGraw Hill Education; 1st edition							
	Useful Links							
1	https://nptel.ac.in/courses/105/105/105105108/							
2	https://nptel.ac.in/courses/105/101/105101086/							
3	http://engineeringvideolectures.com/course/281?pn=0#videolist							
4	https://nptel.ac.in/courses/105/105/105105109/							
5	VisualFEA(Free Student version), Intuition Software, Inc.							
6	RFEM(Free Student version)a <u>3D finite element analysis</u> software							

CO-PO Mapping								
	Programme Outcomes (PO)							
	1 2 3 4 5 6							
CO1	1		3	2		2		
CO2 2 2 2								
CO3			2	2	2	3		
The streng	oth of manning i	s to be written as	1 2 3. Where 1	·Low 2. Mediur	n 3.High			

Assessment								
There are thr	There are three components of lab assessment, LA1, LA2 and Lab ESE.							
IMP: Lab ES	E is a separate hea	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.				
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks				
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30				
	attendance,	Faculty	Marks Submission at the end of Week					
	journal	-	6					
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30				
		Faculty	Marks Submission at the end of Week					
		-	12					
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40				
	journal	Faculty	Marks Submission at the end of Week					
	18							
Week 1 indic	cates starting week	of a semester. The	e typical schedule of lab assessments is she	own,				

considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level					
Bloom's Taxonomy Level	LA1	LA2	ESE	Total	
Remember					
Understand	10			10	
Apply	20	20	20	60	
Analyze		10	10	20	
Evaluate			10	10	
Create					
Total	30	30	40	100	

Walchand College of Engineering, Sangli							
	(Government Aided Autonomous Institute)						
	AY 2021-22						
	Course Information						
Programme	M.Tech. (Structural Engineering)						
Class, Semester	First year M. Tech., Sem I						
Course Code	5ST552						
Course Name	Course Name Activity Based Lab- Theory of Elasticity and Plasticity (PC2)						
Desired Requisites: Solid Mechanics							

Teaching Scheme		Examination Scheme (Marks)				
Lecture		LA1	LA2	ESE	Total	
Tutorial	-	30	30	40	100	
Practical	2 Hrs/week					
Interaction	-	Credits: 1				

	Course Objectives
1	To impart knowledge of various theories of elasticity and apply them to solve 2D Cartesian and polar problems.
2	To impart knowledge of various theories of torsion and apply them to solve 2D torsional problems.
3	To provide knowledge of various theories of plastic behavior and apply them to solve 2D problems.
	Course Outcomes (CO)
CO1	Apply the knowledge of fundamental methods of elasticity for 2-D Cartesian and Polar problems.
CO2	Analyze torsional problems and apprise various theories to solve 2-D torsional problems.
CO3	Discuss the concept of material yielding and plastic behaviour of structures.
	Module Contents
submi inform	nts will be asked to work upon minimum two of the following topics during the semester. They will t the report of each topic containing the information (as per need of topic) like: introduction, general nation, usage/application (if any) detailed description of work/process, relevant diagrams, drawings ulation (if any), observation and results (as applicable) or any other relevant information as per

- v) Demonstrate 2D element, plane stress and plane strain condition by computer program.
- vi) Problems related with torsion of circular sections.
- vii) Study of plastic behaviour of structure in relevant software.

	Text Books						
1	Ameen M., "Computational Elasticity", Alpha Science International, 1 st Revised Edition, 2008.						
2	Singh Sadhu, "Theory of Elasticity", Khanna Publishers, 4th Edition, 2012.						
3	Singh Sadhu, "Theory of Plasticity", Khanna Publishers, 3 rd Edition, 2013						
	References						

2	Chakrabarthy. J, "Theory of Plasticity", Tata McGraw-Hill P. Co. Ltd., 2 nd Edtion, 2007.
3	Johnson W. and Mellor P. B., "Engineering Plasticity", Van Nostrand Reinhold, London, 1973
	Useful Links
1	https://nptel.ac.in/courses/105/105/105105177/
2	https://nptel.ac.in/courses/105/105/105105108/
3	https://nptel.ac.in/courses/105/102/105102090/
4	https://onlinecourses.nptel.ac.in/noc21_ce45/preview

CO-PO Mapping											
		Programme Outcomes (PO)									
	1	1 2 3 4 5 6									
CO1	1		3	2		2					
CO2	1			3		2					
CO3	1			3		2					
The stren	The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High.										

Assessment								
There are thr	ee components of l	ab assessment, LA	A1, LA2 and Lab ESE.					
IMP: Lab ES	E is a separate hea	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation				
Assessment Based on Conducted by Typical Schedule (for 26-week Sem) Marks								
LA1 Lab activities, Lab Course During Week 1 to Week 6								
attendance, Faculty Marks Submission at the end of Week								
journal 6								
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30				
		Faculty	Marks Submission at the end of Week					
			12					
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40				
	journal	Faculty	Marks Submission at the end of Week					
	5	-	18					
			e typical schedule of lab assessments is sh schedule shall be as per academic calo					

considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	LA1	LA2	ESE	Total			
Remember							
Understand	10			10			
Apply	20	20	20	60			
Analyze		10	10	20			
Evaluate			10	10			
Create							
Total	30	30	40	100			

		Walch	and College of	Engineering,	, Sangli			
			(Government Aided Au	tonomous Institute	·)			
			AY 202	1-22				
			Course Info	ormation				
Program	me		M.Tech. (Struct	ural Engineering	()			
Class, Ser	mester		First year M. Te	ech., Sem. II				
Course C	ode		50E102					
Course N	ame		Structural Healt	h Monitoring (O	pen elective)			
Desired H	Requisite	s:	Advanced conc	rete technology				
	Teacl	ning Scheme		Fxaminati	ion Scheme (Mark	(s)		
Lecture	Teuci	2 Hrs/week		T2	ESE	Total		
Tutorial		-	20	20	60	100		
Practical			20	20	00	100		
Interactio)n			Credits: 2				
Interaction	/II							
			Course Ob	jectives				
1	To imp	art knowledge of smar	t materials.					
2	To illus	strate principles of strue	ctural health monitori	ng.				
3	· ·	vide quantitative means er hazardous events.	s to assess the structur	al integrity loss	a system undergoes	after natural disa	sters	
<u> </u>		1 1 1 6	Course Outco	· · ·				
CO1		knowledge of smart ma						
CO2		ise structural condition	•					
CO3	Assess	civil engineering struc	tures by SHM technic	ques and simulati	on.			
Module			Module	Contents			Hou rs	
	Intro	duction to Smart Mat	erials and Their Ap	plications				
Ι	-	ting SHM technologies I fibers and other senso		-	-	-	5	
		stitute relation, unimo						

	materials. (consecutive relations, sensor, actuator, figures of merit), Shape Memory Alloys (Constitutive relation, transition temperatures, shape memory effect, pseudo elasticity, sensor, actuator), Optical Fiber (Fiber Bragg Grating, strain sensing, ultrasonic sensing).						
	Introduction to Structural Health Monitoring (SHM)						
II	Definition & motivation for SHM, SHM - a way for smart materials and structures, SHM and bio mimetic - analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and DECS, basic components of SHM, materials for sensor design.						
III	Condition Survey and NDE of Civil Structure						
	Definition and objective of Condition survey, stages of condition survey (Preliminary, Planning, Inspection and Testing stages), possible defects in concrete structures, quality control of concrete structures - Definition and need, Quality control applications in concrete structures, NDT as an optionfor Non-Destructive Evaluation (NDE) of Concrete structures, case studies of a few NDT procedures on concrete structures,						
	Non Destructive Testing of Concrete Structures						
	SHM of Composite Structures						
IV	Introduction to composites and their applications in structural Industry. Learning from failures. Various kinds of damage detection techniques. Repair &rehabilitation & retrofitting of composite structures, damage assessment of composites structures, Case studies.						
	Introduction to FE Simulations of Various SHM Techniques						
V	Introduction to FE analysis of typical smart materials. Applications of FE simulation technique, case studies 1) Metallic structures 2) Composite structures						
	Advanced Signal Processing						
VI	Methods for Data processing and Result interpretation, Wavelet, Neural networks, Vecto rsupport machine.						
	Textbooks						
	Daniel Balageas, Claus - Peter Fritzenam I Alfredo Guemes, Structural Health Monitoring, Published by	ISTE					
1	Ltd., UK 2006.	1511					
2	Guidebook on Non-destructive Testing of Concrete Structures, Training course series No. 17, Interna Atomic Energy Agency, Vienna, 2002.	ationa					
3	Gandhi, M.V., Thompson B. D., Smart Materials and Structures, ISBN 978-0-412-37010-6.						
	References						
1	Handbook on "Repair and Rehabilitation of RCC Buildings", Published by Director General, CPWD, Go India, 2002.	ovt. o					
2	India, 2002.Handbook on Seismic Retrofitting of Buildings, Published by CPWD & Indian Building Congress in Asso						

	Useful Links
1	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm07/
2	https://onlinecourses.nptel.ac.in/noc20_mm07/preview
3	https://nptel.ac.in/courses/105/108/105108141/

CO-PO Mapping										
		Programme Outcomes (PO)								
	1	2	3	4	5	6				
C01	1		3	2		2				
CO2		2				2				
CO3			2	2	2	3				

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High.

Each CO of the course must map to at least one PO.

Assessment

Assessme	Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	ESE	Total						
Remember								
Understand								
Apply	10	10	10	30				
Analyze	5	10	15	30				
Evaluate	5		15	20				
Create			20	20				
Total	20	20	60	100				

		Walch	and College of	Engineering	, Sangli		
			(Government Aided Au	tonomous Institute	e)		
			AY 202	21-22			
			Course Info	ormation			
Program	me		M.Tech. (Struc	tural Engineering	g)		
Class, Ser	mester		First year M. To	ech., Sem. II			
Course C	ode		5ST521				
Course N	ame		Structural Heal	th Monitoring an	d Retrofitting (PC	3)	
Desired H	Requisite	s:	Solid Mechanic	es, Advanced cor	crete technology		
	Teer	ning Scheme		Fyaminat	tion Scheme (Mar	-ke)	
Lecture	Itaci	3 Hrs/week		T2	ESE	Total	
Tutorial			20	20	60 ESE	100	
Practical		-		20	00	100	
Interactio							
meraen							
			Course Ob	jectives			
1	To imp	art knowledge of smart					
2	To illu	strate principles of struc	ctural health monitor	ng.			
3	· ·	vide quantitative means her hazardous events.	to assess the structu	ral integrity loss	a system undergoe	es after natural disa	sters
			Course Outco	omes (CO)			
CO1		knowledge of smart ma	•				
CO2		ise structural conditions	• •				
CO3	Assess	civil engineering struct	tures by SHM technic	ques and simulat	ion.		
				<u> </u>			TT
Module			Module	Contents			Hou rs
Ι	Emerg optica Const electro mater	duction to Smart Mat ging SHM technologies l fibers and other sense itute relation, unimorp patrictive materials, (co als. (consecutive relation) Contents for M. Tech.	s, using piezo sensors ors. Overview of app h, bi-orph, electrom onsecutive relations, ations, sensor, actu	s, SHM using m lication potentia lechanical, coe sensor, actuator, ator, figures o	l of SHM. Piezoe fficient, resonance , figures of merit), f merit), Shape	lectric materials (e/ antiresonance), Magnetostrictive Memory Alloys	7

	(Constitutive relation ,transition temperatures, shape memory effect, pseudo elasticity, sensor,					
	actuator), Optical lFiber (Fiber Bragg Grating, strainsensing, ultrasonic sensing).					
	Introduction to Structural Health Monitoring (SHM)					
Π	Definition & motivation for SHM, SHM - a way for smart materials and structures, SHM and bio mimetic - analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and DECS, basic components of SHM, materials for sensor design.					
	Condition Survey & NDE of Civil Structure					
III	Definition and objective of Condition survey, stages of condition survey (Preliminary, Planning, Inspection and Testing stages), possible defects in concrete structures, quality control of concrete structures - Definition and need,Quality control applications in concrete structures, NDT as an optionfor Non-Destructive Evaluation (NDE) of Concrete structures, case studies of a few NDT procedures on concrete structures,	7				
	Non Destructive Testing of Concrete Structures: Introduction to NDT - Situations and contexts, where NDT is needed, classification of NDT procedures, visual Inspection, half-Cell electrical potential methods, Schmidt Rebound Hammer Test, resistivity measurement, electromagnetic methods, radiographic Testing, ultrasonic testing, Infra-Red thermography, ground penetrating radar, radioisotope gauges, other methods.					
	SHM of Composite Structures					
IV	Introduction to composites and their applications in structural Industry. Learning from failures Various kinds of damage detection techniques. Repair & rehabilitation & retrofitting of composite structures, damage assessment of composites structures, Case studies.					
	Introduction to FE Simulations of Various SHM Techniques					
V	Introduction to FE analysis of typical smart materials. Applications of FE simulation technique, case studies 1) Metallic structures 2) Composite structures	6				
	Advanced Signal Processing					
VI	Methods for Data processing and Result interpretation, Wavelet, Neural Networks, Vector Support Machine.	6				
	Textbooks					
1	Daniel Balageas, Claus - Peter Fritzenam I Alfredo Guemes, Structural Health Monitoring, Published by Ltd., UK 2006.					
2	Guidebook on Non-destructive Testing of Concrete Structures, Training course series No. 17, Interna	tiona				
3	Atomic Energy Agency, Vienna, 2002. Gandhi, M.V., Thompson B. D., Smart Materials and Structures, ISBN 978-0-412-37010-6.					
	References					
1	Handbook on "Repair and Rehabilitation of RCC Buildings", Published by Director General, CPWD, Go India, 2002.	ovt. o				
2	2 Handbook on Seismic Retrofitting of Buildings, Published by CPWD & Indian Building Congress in Association					
^	Handbook on Seismic Retrofitting of Buildings, Published by CPWD & Indian Building Congress in Assoc	ciat				

	with IIT, Madras, Narosa Publishing House, 2008.
	Useful Links
1	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm07/
2	https://onlinecourses.nptel.ac.in/noc20_mm07/preview
3	https://nptel.ac.in/courses/105/108/105108141/

CO-PO Mapping								
		Programme Outcomes (PO)						
	1	2	3	4	5	6		
C01	1		3	2		2		
CO2		2				2		
CO3			2	2	2	3		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High.

Each CO of the course must map to at least one PO.

Assessment

Assessme	ent Plan based	on Bloom's T	Faxonomy Lev	vel
Bloom's Taxonomy Level	T1	T2	ESE	Total
Remember				
Understand				
Apply	10	10	10	30
Analyze	5	10	15	30
Evaluate	5		15	20
Create			20	20
Total	20	20	60	100

		Walc		ege of Engin		ngli	
				AY 2021-22			
			Cou	rse Informati	on		
Progra	amme		M.Tech. (Stu	ructural Engine	eering)		
	Semester			I. Tech., Sem.			
Cours	e Code		5ST522				
Cours	e Name		Finite Eleme	ent Method (PO	C4)		
Desire	d Requisi	tes:	Mechanics of	of Structures			
Teaching Scheme				Exami	nation Schen	ne (Marks)	
Lectur		3 Hrs/week	T1	T2	ESE	Total	
Tutori		-	20	20	60	100	
Practi		-		1	1	1	
Intera		_			Credits: 3	}	
		1	1				
			Co	urse Objectiv	es		
1	To impa	rt knowledge of		•		ements.	
2	-	ss finite elemen					
3		rate applications		-	-	namics	
3		are applications	of real for p	iates, shells an	a su actural dy	nallics.	
			Cours	se Outcomes (
CO1	Implem	ent finite eleme			,	problems	
CO2		nodal degrees of					
CO3		finite element m				•	
						·	
Modu	le		Mo	odule Content	s		Hours
	4						
	1-D]	Elements					
			concept of f	finite element	analysis, Dis	cretization, nodes,	
	1-D	Elements Basic				cretization, nodes, ection of order of	
Т	1-D elem	Elements Basic ent incidences,	displacement	model, shape	function, sel		8
I	1-D elem polyr subje	Elements Basic ent incidences, nomials, applicated to axial	displacement ation to bars forces. Princi	model, shape with constan ple of minim	function, sel nt and varial um potential	ection of order of ole cross sections energy, variation	8
Ι	1-D elem polyr subje princ	Elements Basic ent incidences, nomials, applic cted to axial iple, developme	displacement ation to bars forces. Princi ant of element	model, shape with constan ple of minim stiffness matri	function, sel nt and varial um potential x and nodal lo	ection of order of ble cross sections energy, variation ad vector for truss,	8
Ι	1-D elem polyn subje princ beam	Elements Basic ent incidences, nomials, applica- cted to axial iple, developme and plane fram	displacement ation to bars forces. Princi int of element ne elements, T	model, shape with constan ple of minim stiffness matri	function, sel nt and varial um potential x and nodal lo	ection of order of ole cross sections energy, variation	8
I	1-D elem polyn subje princ beam engin	Elements Basic ent incidences, nomials, applica- tected to axial iple, developme and plane fran- neering applicati	displacement ation to bars forces. Princi int of element ne elements, T	model, shape with constan ple of minim stiffness matri	function, sel nt and varial um potential x and nodal lo	ection of order of ble cross sections energy, variation ad vector for truss,	8
I	1-D elem polyn subje princ beam engin 2-D	Elements Basic ent incidences, nomials, applica octed to axial iple, developme and plane fran meering applicati Elements	displacement ation to bars forces. Princi- nt of element ne elements, Tons.	model, shape with constan ple of minim stiffness matri Transformation	function, sel nt and varial um potential x and nodal lo n of matrices,	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural	8
	1-D elem polyn subje princ beam engin 2-D	Elements Basic ent incidences, nomials, applica octed to axial iple, developme and plane fran heering applicati Elements Elements 2-D el	displacement ation to bars forces. Princi- ent of element ne elements, Tons.	model, shape with constant ple of minim stiffness matric Transformation ngular and qua	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural	
I II	1-D elem polyn subje princ beam engin 2-D and	Elements Basic ent incidences, nomials, applica- cted to axial iple, developme and plane fran- neering applicati Elements Elements 2-D el plane strain pr	displacement ation to bars forces. Princi ent of element ne elements, T ons. ements of tria roblems. Pasc	model, shape with constant ple of minim stiffness matrix Fransformation ngular and qua al's triangle,	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence	ection of order of ole cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and	8
	1-D elem polyn subje princ beam engin 2-D 2 and comp	Elements Basic ent incidences, nomials, applica- ected to axial iple, developme and plane fran- neering applicati Elements Elements 2-D el plane strain pro- patibility condit	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria roblems. Pasc ions, shape fu	model, shape with constant ple of minim stiffness matrix Fransformation ngular and qua al's triangle,	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural	
	1-D elem polyn subje princ beam engin 2-D and comp ratio	Elements Basic ent incidences, nomials, applica- toted to axial iple, developme and plane fran- theering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria roblems. Pasc ions, shape fu	model, shape with constant ple of minim stiffness matrix Fransformation ngular and qua al's triangle,	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence	ection of order of ole cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and	
II	1-D elem polyn subje princ beam engin 2-D 2-D and comp ratio.	Elements Basic ent incidences, nomials, applica- icted to axial iple, developme and plane fran- neering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria coblems. Pasc ions, shape fu a continuum.	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition	ection of order of ole cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and	6
	1-D elem polyn subje princ beam engin 2-D and comp ratio, 3-D	Elements Basic ent incidences, nomials, applica- ected to axial iple, developme a and plane fran eering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo	displacement ation to bars forces. Princi- ent of element ons. ements of tria- coblems. Pasc ions, shape fu a continuum.	model, shape with constant ple of minim stiffness matri Transformation ngular and qua cal's triangle, unctions, boun ment stiffness	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect	
II	1-D elem polyn subje princ beam engin 2-D 2-D and comp ratio, 3-D Tetra	Elements Basic ent incidences, nomials, applica- ected to axial iple, developme a and plane fran eering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria roblems. Pasc ions, shape fu a continuum. opment of eler edral elements	model, shape with constant ple of minim stiffness matri. Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for	6
II	1-D elem polyn subje princ beam engin 2-D 2-D and comp ratio, 3-D 3-D Tetra elem Isop	Elements Basic ent incidences, nomials, applica- acted to axial iple, developme and plane fran- meering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo- hedron, Hexaho ent stiffness mate erimetric Elements	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria coblems. Pasc ions, shape fu a continuum. opment of elements rix and nodal nent Isoperin	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural	6
II	1-Delempolynsubjeprincbeamengin2-Dandcompratio,3-D3-DTetraelemIsopecoord	Elements Basic ent incidences, nomials, applica- icted to axial iple, developme a and plane fran neering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo- hedron, Hexaho ent stiffness mat erimetric Eler linate systems	displacement ation to bars forces. Princi- ent of element ons. ements of tria- roblems. Pasc ions, shape fu a continuum. opment of elements trix and nodal ment Isoperin, classification	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape rimetric- sub	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural	6
II	1-D elem polyn subje princ beam engin 2-D 2-D and comp ratio, 3-D Tetra elem Isopo coord paran	Elements Basic ent incidences, nomials, applica- ected to axial iple, developme a and plane fran- neering applicati Elements Elements 2-D el plane strain pro- patibility condita applications to Elements Elements Develo- hedron, Hexaha ent stiffness mata erimetric Elements, netric elements,	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria roblems. Pasc ions, shape fu a continuum. opment of elements rix and nodal nent Isoperia , classificatio 1-D & 2-D iso	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape rimetric- sub	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural	6
II	1-Delempolynsubjeprincebeamengin2-D 12-D 2andcompratio.3-D 13-D 2TetraelemIsopocoordparanGauss	Elements Basic ent incidences, nomials, applica- acted to axial iple, developme a and plane fran- heering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo- hedron, Hexahe ent stiffness mate erimetric Elements, s-quadrature int	displacement ation to bars forces. Princi- int of element ne elements, Tons. ements of tria roblems. Pasc ions, shape fu a continuum. opment of elements rix and nodal nent Isoperin , classificatio 1-D & 2-D iso egration.	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape rimetric- sub	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural	6
II III IV	1-Delempolynsubjeprincebeamengin2-Dandcompratio,3-D3-DTetraelemIsopocoordparanGaussPlate	Elements Basic ent incidences, nomials, applica- acted to axial iple, developme and plane fran- meering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo- hedron, Hexaho ent stiffness mate erimetric Elements, s-quadrature int e and Shell Elements	displacement ation to bars forces. Princi- ent of element ne elements, Tons. ements of tria coblems. Pasc ions, shape fu a continuum. opment of eler edral elements rix and nodal nent Isoperir , classificatio 1-D & 2-D iso egration. nents	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper operimetric ele	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape timetric- sub ments,	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural prarmatric, super	6
II	1-Delempolynsubjeprincebeamengin2-Dand2-Dandcompratio,3-D3-D3-DTetraelemIsopecoordparanGausPlatePlate	Elements Basic ent incidences, nomials, applica- icted to axial iple, developme a and plane fran- neering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo- hedron, Hexaho ent stiffness mat erimetric Eler linate systems netric elements, s-quadrature int e and Shell Eler and Shell Elements	displacement ation to bars forces. Princi- ent of elements ons. ements of tria- roblems. Pasc ions, shape fu a continuum. opment of eler edral elements rix and nodal nent Isoperir, classificatio 1-D & 2-D iso egration. nents ents Formation	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper operimetric element operimetric element	function, sel nt and varial um potential x and nodal lo a of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape timetric- sub ments, natrix for plate	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural prarmatric, super	6
II III IV	1-Delempolynsubjeprincebeamengin2-Dand2-Dandcompratio3-D3-DTetraelemIsopecoordparanGaussPlateof tri	Elements Basic ent incidences, nomials, applica- icted to axial iple, developme a and plane fran- neering applicati Elements Elements 2-D el plane strain pro- patibility condit applications to Elements Elements Develo- hedron, Hexahe ent stiffness mate erimetric Elements, s-quadrature int and Shell Elem angular and qua	displacement ation to bars forces. Princi- ent of element ons. ements of tria- roblems. Pasc ions, shape fu a continuum. opment of elements rix and nodal nent Isoperin , classificatio 1-D & 2-D iso egration. nents ents Formation drilateral shap	model, shape with constant ple of minim stiffness matric Transformation ngular and qua cal's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper operimetric ele n of stiffness r es, cylindrical	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape timetric- sub ments, natrix for plate thin shell elem	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural prarmatric, super	6 6
II III IV	1-Delempolynsubjeprincebeamengin2-D 12-D 2andcompratio.3-D 13-D 2TetraelemIsopocoordparanGausPlateof triFinit	Elements Basic ent incidences, nomials, applica- acted to axial iple, developme a and plane fran- heering applicati Elements Elements 2-D el plane strain pro- batibility condit applications to Elements Elements Develo- hedron, Hexahe ent stiffness mate erimetric Elements, s-quadrature int e and Shell Elem angular and qua e Element App	displacement ation to bars forces. Princi- int of element ne elements, To ons. ements of tria roblems. Pasc ions, shape fu a continuum. opment of elements rix and nodal nent Isoperin , classification 1-D & 2-D iso egration. nents ents Formation drilateral shap lications to St	model, shape with constant ple of minim stiffness matri Transformation ngular and qua al's triangle, unctions, boun ment stiffness s, Ax symmet load vector. metric Eleme on of isoper operimetric ele n of stiffness r es, cylindrical tructural Dyn	function, sel nt and varial um potential x and nodal lo n of matrices, adrilateral shap convergence dary condition matrix and no ric Elements ents Shape timetric- sub ments, natrix for plate thin shell elem amics	ection of order of ble cross sections energy, variation ad vector for truss, relevant structural bes for plane stress requirements and ns, element aspect dal load vector for - Development of function, Natural prarmatric, super	6 6

	Textbooks
1	Seshu P. N., "Finite Element Analysis", 2003.
•	Reddy J. N., "An Introduction to the Finite Element Method" McGraw Hill, 3rd Edition, New
2	York, 2006.
3	Cook Robert D., Malkus David S., Plesha Michael E., and Witt Robert J., "Concepts and
3	Applications of Finite Element Analysis", 2003

1	Bathe Klaus-Jurgen, "Finite Element Procedures in Engineering Analysis", 1982.				
2	Chandrupatla T. R. and Belegundu A. D., "Introduction to Finite Element in Engineering",				
2	Prentice.				
3	Zienkiewicz. O. C. & Taylor. R. L., "The Finite Element Method- Vol I & Vol II Tata				
5	McGraw-Hill Publishing Company Limited, 1989, 4th Edition.				
	Useful links				
1	https://nptel.ac.in/courses/105/107/105107209/				
2	https://nptel.ac.in/courses/105/106/105106051/				
3	https://nptel.ac.in/courses/112/104/112104116/				

CO-PO Mapping							
	Programme Outcomes (PO)						
	1	2	3	4	5	6	
CO1	1	2		2			
CO2		3		2		2	
CO3	1		2			3	
The streng	oth of manning i	s to be written as	s 1 2 3. Where 1	·Low 2.Mediu	m 3.High		

Assessment

Assessment Plan based on Bloom's Taxonomy Level						
Bloom's Taxonomy Level	T1	T2	ESE	Total		
Remember						
Understand						
Apply	10	10	10	30		
Analyze	5	10	15	30		
Evaluate	5		15	20		
Create			20	20		
Total	20	20	60	100		

			Walc	hand College of	f Engineeri	ng, Sangli	
	(Government Aided Autonomous Institute) AY 2021-22						
				Course In	formation		
Programme				M.Tech. (Structura	al Engineering)		
Class, Semester				First year M. Tech	., Sem. II		
Course Code				5ST523			
Cours	e Na	ame		Advanced Earthqu	ake Engineerin	g (PE 3)	
Desire	ed R	equisi	tes:	Dynamics of Struc	ctures		
	Tea	ching	Scheme		Examination	Scheme (Marks)	
Lectur	e		2 Hrs/week	T1	T2	ESE	Total
Tutori	al		-	20	20	60	100
Practic	cal		-			I	
Interac	ctior	1	-	Credits: 2			
			1	1			
				Course (Objectives		
1	To	provi	de knowledge o	f various concepts of	f earthquake res	istant design of stru	ctures.
2	To	impar	t the knowledge	e of modelling and a	nalysis of struct	ures for displaceme	nt-based design.
3		o illustr uctures		avior and codal prov	visions for desig	n of various earthqu	iake resistant
	1			Course Out	tcomes (CO)		
CO1	Di	fferen	tiate various co	ncepts of earthquake	e resistant desig	n of structures.	
CO2	Ca	alculat	e response of st	ructures for displace	ment and perfo	rmance-based desig	<u>n.</u>
CO3	De	esign e	arthquake resist	ant structures based	on its performa	nce.	
Modu	ıle			Module	Contents		Hours
Ι		Conc	onto of Fouth ~	uako Dogistant Dogi	ian		
		Force input	based vs. disp	uake Resistant Desi placement-based des and their effect or les.	sign, performar	-	

	Modelling and Analysis of Structures for Displacement Based Design	
II	Back-bone curve, Idealized component models, estimation and modelling of stiffness, strength and ductility of RC, steel and masonry structures, nonlinear static and dynamic analyses.	5
III	Direct Displacement Based Design	
m	Structure performance objectives, performance levels and limit states; P-Delta effects; Torsion; Capacity design for direct displacement-based design.	5
	Performance Based Design	
IV	Structural and non-structural performance, quantification of performance, performance evaluation of structures, services and equipment.	5
	Overhead Water Tanks	
V	Modelling and analysis of overhead water tanks, hydrostatic and hydrodynamic effects, earthquake resistant provisions.	5
	Seismic Risk Assessment	
VI	Seismic vulnerability assessment, HAZUS, Different types of MBT, Fragility curve, DPM, Simplified Vulnerability assessment as per ASCE 41.Assesment procedures of NDT results	5
	· · · · · · · · · · · · · · · · · · ·	
	Textbooks	
1	Textbooks Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structu publications, New Delhi, 3 rd Edition, 2006.	res", PH
1 2	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structu	
	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structu publications, New Delhi, 3 rd Edition, 2006. Key David, "Earthquake Design Practice for Buildings", Thomas Telford P	ublicatio
2	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structu publications, New Delhi, 3 rd Edition, 2006. Key David, "Earthquake Design Practice for Buildings", Thomas Telford P London, 2 nd Edition, 2006. Paulay, T. and Priestley, M.J.N. "Seismic Design of Reinforced Concrete and	ublicatio
2	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structur publications, New Delhi, 3 rd Edition, 2006. Key David, "Earthquake Design Practice for Buildings", Thomas Telford P London,2 nd Edition, 2006. Paulay, T. and Priestley, M.J.N. "Seismic Design of Reinforced Concrete and Buildings," John Wiley & Sons, 1992.	ublicatio
2 3	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structu publications, New Delhi, 3 rd Edition, 2006. Key David, "Earthquake Design Practice for Buildings", Thomas Telford P London,2 nd Edition, 2006. Paulay, T. and Priestley, M.J.N. "Seismic Design of Reinforced Concrete and Buildings," John Wiley & Sons, 1992. References Kelly James M., "Earthquake Resistant Design with Rubber", Springer-Verlag P	ublicatio
2 3 1	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structur publications, New Delhi, 3 rd Edition, 2006. Key David, "Earthquake Design Practice for Buildings", Thomas Telford P London,2 nd Edition, 2006. Paulay, T. and Priestley, M.J.N. "Seismic Design of Reinforced Concrete and Buildings," John Wiley & Sons, 1992. References Kelly James M., "Earthquake Resistant Design with Rubber", Springer-Verlag P London, 2 nd Edition, 2012. George G. Penelis and Andreas J. Kappos, "Earthquake Resistant Concrete Structure	ublicatio I Masoni ublicatio ures," E
2 3 1 2	Agarwal P. andShrikhande M., "Earthquake Resistant Design of Structur publications, New Delhi, 3 rd Edition, 2006. Key David, "Earthquake Design Practice for Buildings", Thomas Telford P London,2 nd Edition, 2006. Paulay, T. and Priestley, M.J.N. "Seismic Design of Reinforced Concrete and Buildings," John Wiley & Sons, 1992. References Kelly James M., "Earthquake Resistant Design with Rubber", Springer-Verlag P London, 2 nd Edition, 2012. George G. Penelis and Andreas J. Kappos, "Earthquake Resistant Concrete Structur FN Spon, 1997. FEMA-356, "Prestandard and Commentary for the Seismic Rehabilitation of E	ublication I Masoni ublicatio

2	https://nptel.ac.in/courses/105/104/105104200/
3.	https://nptel.ac.in/courses/105/108/105108204/
4.	https://nptel.ac.in/courses/105/107/105107204/
5.	https://nptel.ac.in/courses/105/101/105101004/

	Programme Outcomes (PO)						
	1	2	3	4	5	6	
CO1		2	2			2	
CO2	1			3		2	
CO3			2	2		2	

Assessment

Assessment Plan based on Bloom's Taxonomy Level						
oom's Taxonomy Level	T1	T2	ESE	Total		
Remember						
Understand						
Apply	10	10	10	30		
Analyze	5	10	15	30		
Evaluate	5		15	20		
Create			20	20		
Total	20	20	60	100		

V	Valchand College of Engineering, Sangli			
	(Government Aided Autonomous Institute)			
	AY 2021-22			
	Course Information			
Programme M.Tech. (Structural Engineering)				
Class, Semester First year M. Tech., Sem. II				
Course Code 5ST524				
Course NameNumerical Methods in Structural Engineering (PE3)				
Desired Requisites: Applied Mathematics, Structural Engineering				

Teaching Scheme		Examination Scheme (Marks)				
Lecture	2 Hrs/week	T1	T2	ESE	Total	
Tutorial	-	20	20	60	100	
Practical	-			· · · ·		
Interaction	-	Credits: 2				

	Course Objectives					
1	To provide knowledge of Matrix methods and statistical tools for solution of problems.					
2	To impart knowledge of numerical differentiation, integration, root finding, curve fitting and other					
2	numerical approximations.					
3	To provide exposure to field application of numerical methods in structural engineering.					
	Course Outcomes (CO)					
CO1	Execute numerical recipes for problem solving in engineering.					
CO2	Examine different numerical tools for solution of engineering problems.					
CO3	Discuss numerical schemes for modelling and solving field applications.					

Module	Module Contents	Hours
I	Solving Linear Algebraic Equations and Eigen Analysis System of linear algebraic equations, conditions for existence of solution, Classification of solution approaches as direct and iterative, solution by matrix decomposition, Introduction to methods for solving Block-diagonal, triangular, block-triangular systems. Introduction to sparse linear systems: Thomas algorithm for tridiagonal and block tridiagonal matrices, Iterative methods: Jacobi, Gauss- Siedel and successive over relaxation methods, Convergence of iterative solution schemes. Ill conditioning of equations. Eigen Analysis by Jacobi and other Methods.	8
Ш	Solving Nonlinear Algebraic Equations [Root Locating methods] Method of successive substitutions derivative free iterative solution approaches, Secant method, regulafalsi method, Modified Newton's method and qausi-Newton method with Broyden's update, Optimization based formulations and Leverberg- Marquardt method	7
ш	Solving Ordinary Differential Equations and Approximations Solutions of Linear ODE-IVPs by implicit and explicit methods, Taylor series based and Runge-Kutta methods, Multi-step approaches, Stability issues. Problem discretization using approximation theory, polynomial approximations, Finite difference method for solving ODE-BVP with examples, Polynomial and function interpolations, Least square approximations, Model Parameter Estimation using linear least squares method, Gauss Newton Method.	6
IV	Probability, Statistics, Reliability Analysis Probability basics and applications in engineering, Statistical parameters, distributions, methods and applications. Reliability analysis in structural	8

	engineering.					
V	Numerical Integration					
	Newton-Cotes schemes, Romberg, Gauss-quadrature, Multiple Integrals.	7				
	Structural Engineering Applications					
VI	Digital Signal Processing, Nonlinear structural analysis, Structural dynamics and					
	Earthquake engineering applications. SHM.	6				
	Textbooks					
		w Hill 7th				
1	Chapra Steven and Canale Raymond, "Numerical Methods for Engineers", Mc-Graw Hill, 7th Edition, 2012.					
_	Gourdin A. and Boumhrat M., "Applied Numerical Methods", Prentice Hall India, New Delhi,					
2	2000.					
2	Joe D Hoffman, "Numerical Methods for Engineers and Scientists", Marcel Dekker, 2nd					
3	3 Edition, 2001.					
	References					
1	Gilbert Strang, "Computational Science and Engineering", Wellesley-Cambridge Pr	ess.				
2	Gilbert Strang, "Linear Algebra and Its Applications", Wellesley Cambridge Press, 4th					
2	Edition, 2009.					
3	Philips, G. M., and Taylor P. J. "Theory and Applications of Numerical Analysis", Academic					
5	Press, 2nd Edition, 1996.					
	Useful links					
1	https://nptel.ac.in/courses/105/105/105105043/					
2	https://nptel.ac.in/courses/111/107/111107107/					
3	https://nptel.ac.in/courses/111/107/111107105/					

CO-PO Mapping							
	Programme Outcomes (PO)						
	1	2	3	4	5	6	
CO1	1		2				
CO2	1		2				
CO3	1			3		3	
The stren	gth of mapping i	s to be written as	5 1.2.3: Where, 1	: Low, 2: Mediu	m. 3: High.		

Assessment

Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	T1	T2	ESE	Total			
Remember							
Understand							
Apply	10	10	10	30			
Analyze	5	10	15	30			
Evaluate	5		15	20			
Create			20	20			
Total	20	20	60	100			

AY 2021-22 Course Information Programme M.Tech. (Civil - Structural Engineering) Class, Semester First Year M. Tech., Sem. II Course Code S5T535 Course Name Analysis and Design of Bridges (PE4) Desired Requisites: Design of Concrete Structures Course Name Total Course Objectives Course Objectives Interaction - Course Objectives To provide knowledge of loads and analysis for different types of bridges. To impart knowledge for construction, inspection and maintenance of bridges. Course Outcomes (CO) Col Module Contents Introduction to Bridge Course Objectives Course Objectives Course Objectives Course Objectives To impart knowledge for construction, inspection and maintenance of bridges. Coursero Untomes (CO) <th colsp<="" th=""><th></th><th>Walc</th><th>chand College (Government Aid</th><th></th><th></th><th>nglı</th><th></th></th>	<th></th> <th>Walc</th> <th>chand College (Government Aid</th> <th></th> <th></th> <th>nglı</th> <th></th>		Walc	chand College (Government Aid			nglı	
Programme M. Tech. (Civil - Structural Engineering) Class, Semester First Year M. Tech., Sem. II Course Code SST525 Course Name Analysis and Design of Bridges (PE4) Desired Requisites: Design of Concrete Structures Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - Interaction - Credits: 2 1 To provide knowledge of loads and analysis for different types of bridges. To impart knowledge for construction, inspection and maintenance of bridges. To impart knowledge for construction, inspection and maintenance of bridges. 2 To provide knowledge for construction, inspection and maintenance of bridges. CO2 2 To provide knowledge for construction, inspection and maintenance of bridges. CO2 2 Components of bridges, their components and selection of bridge site. CO2 2 Components of bridges, Importance of bridges, Types of bridges, Selection of bridge type and site, Economic span, Superstructure – Alignment, Drainage, Clearance, Road curb, Design loads for bridges, IRC Loading Design of RC Culvert, Pipe culvert, Box culvert.			1					
Class, Semester First Year M. Tech., Sem. II Course Code 5ST525 Course Name Analysis and Design of Bridges (PE4) Desired Requisites: Design of Concrete Structures Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - Course Objectives Total Interaction - Course Objectives - I To provide knowledge of loads and analysis for different types of bridges. - - 2 Course Objectives - - - 3 To provide knowledge for construction, inspection and maintenance of bridges. - - Course Outcomes (CO) Module Module Contents I D Module Module Contents I D - I Top rovide knowledge for design of bridges, their components and selection of bridges, Selection of bridges and bearings along with reinforcement details. I Module Module Contents I I D Intr					on			
Class, Semester First Year M. Tech., Sem. II Course Code SST525 Course Name Analysis and Design of Bridges (PE4) Desired Requisites: Design of Concrete Structures Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - Course Objectives Total Interaction - Course Objectives Credits: 2 Interaction - Course Objectives - 2 To provide knowledge of loads and analysis for different types of bridges. Course Outcomes (CO) C01 Illustrate types of bridges, their components and selection of bridge site. CO2 Analysis of bridges, their components and selection of bridges site. D C02 Analyse avaious types of bridges, with appropriate loads and methods. D D C03 Design of bridges, Importance of bridge, Types of bridges, Selection of bridge type and site. Economic span, Superstructure – Alignment, Drainage, Clearance, Road curb, Design loads for bridge, IRC Loading I I Design of RC Culvert, Fipe culvert, Box culvert. RC Deck Slab	Progra	amme	M.Tech. (Civil	- Structural	Engineering)			
Course Code SST525 Course Name Analysis and Design of Bridges (PE4) Desired Requisites: Design of Concrete Structures Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - - Credits: 2 - Interaction - Course Objectives - - 1 To provide knowledge of loads and analysis for different types of bridges. - - - 2 To impart knowledge for construction, inspection and maintenance of bridges. - - - 3 To provide knowledge for construction, inspection and maintenance of bridges. - - - CO1 Illustrate types of bridges, their components and selection of bridge site. - - - CO2 Analyze various types of bridges, funportance of bridges, IRC Loading - - - Ill Introduction to Bridge - - - - -					<u> </u>			
Course Name Analysis and Design of Bridges (PE4) Desired Requisites: Design of Concrete Structures Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - - Course Objectives - Interaction - Course Objectives - - 1 To provide knowledge of loads and analysis for different types of bridges. - - - 2 To impart knowledge for construction, inspection and maintenance of bridges. - - - 3 To provide knowledge for construction, inspection and maintenance of bridges. - - - CO2 Analyze various types of bridges with appropriate loads and methods. CO3 Design of bridge. - 1 1 To duction to Bridge - Analysis of Cuverts 1 1 1 Module Module Contents 1 1 1 1 Malysis of Cuver								
Desired Requisites: Design of Concrete Structures Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - - - - - Interaction - Course Objectives - - - 1 To provide knowledge of loads and analysis for different types of bridges. - - - - 2 To impart knowledge for construction, inspection and maintenance of bridges. - - - - 3 To provide knowledge for construction, inspection and maintenance of bridges. -				esign of Br	dges (PE4)			
Teaching Scheme Examination Scheme (Marks) Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - 20 20 60 100 Interaction - Credits: 2 - - Interaction - Credits: 2 - - To provide knowledge for classing of different types of bridges. - - - To provide knowledge for construction, inspection and maintenance of bridges. - - - Course Outcomes (CO) CO 1 - - - Ol Illustrate types of bridges, their components and selection of bridge site. - - - CO Illustrate types of bridge, Importance of bridge, Types of bridges, Selection of bridge type and site, Economic span. Superstructure – Alignment, Drainage, Clearance, Road curb, Design loads for bridge, IRC Loading - I Design of RC dck slab. Beam and slab, T-beam bridge, Pigeaud's theory, Corbon's theory, Balanced cantilever bridge. - I Prestressed Concrete Bridges – General aspec			-		-			
Lecture 2 Hrs/week T1 T2 ESE Total Tutorial - 20 20 60 100 Practical - - Credits: 2 Interaction - Credits: 2 To provide knowledge of loads and analysis for different types of bridges. To impart knowledge for design of different types of bridges including substructures with codes. 3 To provide knowledge for construction, inspection and maintenance of bridges. CO1 Illustrate types of bridges, their components and selection of bridge site. CO2 Analyze various types of bridges, usin papropriate loads and methods. CO3 Design of bridges and bearings along with reinforcement details. Module Module Contents 1 Introduction to Bridge Importance of bridge, Types of bridges, Selection of bridge type and site, Economic span, Superstructure – Alignment, Drainage, Clearance, Road curb, Design loads for bridges, IRC Loading 1 II Analysis of Culverts 1 III Design of RC deck slab, Beam and slab, T-beam bridge, Pigeaud's theory, Corbon's theory, Balanced cantilever bridge. V Prestressed Concrete Bridges Ousenotethore slab on steel plate girder, Stifteners, Shear co								
Tutorial - 20 20 60 100 Practical - Credits: 2 Interaction - Credits: 2 1 To provide knowledge of loads and analysis for different types of bridges. 2 To impart knowledge for design of different types of bridges including substructures with codes. 3 To provide knowledge for construction, inspection and maintenance of bridges. COurse Outcomes (CO) CO C01 Illustrate types of bridges, their components and selection of bridge site. C02 Analyze various types of bridges with appropriate loads and methods. C03 Design of bridges and bearings along with reinforcement details. Module Module Contents 1 Components of bridge, Importance of bridges, Types of bridges, Selection of bridge type and site, Economic span, Superstructure – Alignment, Drainage, Clearance, Road curb, Design loads for bridges, IRC Loading 11 Analysis of Culvert, Box culvert. RC Deck Slabs Design of RC deck slab, Beam and slab, T-beam bridge, Pigeaud's theory, Corbon's theory, Balanced cantilever bridge. IV Prestressed Concrete Bridges IV Prestressed Concrete Bridges V Design of Substructure V Design o				Exami		e (Marks)		
Practical Interaction - Credits: 2 Interaction - Course Objectives 1 To provide knowledge of loads and analysis for different types of bridges. 2 To impart knowledge for design of different types of bridges including substructures with codes. 3 To provide knowledge for construction, inspection and maintenance of bridges. C01 Illustrate types of bridges, their components and selection of bridge site. C02 Analyze various types of bridges with appropriate loads and methods. C03 Design of bridges and bearings along with reinforcement details. Module Module Contents Introduction to Bridge. Introduction to Bridge. Components of bridge, Importance of bridges, Types of bridges, Selection of bridge type and site, Economic span, Superstructure – Alignment, Drainage, Clearance, Road curb, Design loads for bridges, IRC Loading II Analysis of Culverts Design of RC deck slab, Beam and slab, T-beam bridge, Pigeaud's theory, Corbon's theory, Balanced cantilever bridge. Prestressed Concrete Bridges IV Prestressed Concrete Bridges V Design of composite Bridges. V Design of substructure Design of substructure Abutment, Pier, Approach slab, Pile and well foundation. Bearings and expa	Lectur	e 2 Hrs/week	T1	T2	ESE	Total		
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2	Raina V. K., "Concrete Bridge Practice: Analysis, design and economics", Tata Mc Graw Hill Publishing Company, New Delhi.				
3	IRC Codes.				
Useful Links					
1	Reinforced Concrete Road Bridges - Course (nptel.ac.in)				
2	NPTEL :: Civil Engineering - NOC:Reinforced Concrete Road Bridges				

	CO-PO Mapping						
			Programme C	Dutcomes (PO)			
	1 2 3 4 5 6						
CO1	1		2	3		2	
CO2			2	2	1	2	
CO3			2	2	1	2	

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also, there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessme	Assessment Plan based on Bloom's Taxonomy Level					
Bloom's Taxonomy Level	Bloom's Taxonomy Level T1 T2 ESE Total					
Remember						
Understand						
Apply	10	10	10	30		
Analyze	5	10	15	30		
Evaluate	5		15	20		
Create			20	20		
Total	20	20	60	100		

V	Walchand College of Engineering, Sangli				
	(Government Aided Autonomous Institute)				
	AY 2021-22				
	Course Information				
Programme M.Tech. (Structural Engineering)					
Class, Semester	First year M. Tech., Sem. II				
Course Code	5ST526				
Course Name	Theory of Plates and Shells (PE4)				
Desired Requisites: Theory of Elasticity and Plasticity					

Teaching Scheme		Examination Scheme (Marks)				
Lecture	2 Hrs/week	T1	T2	ESE	Total	
Tutorial	-	20	20	60	100	
Practical	-	·		· · ·		
Interaction	-	Credits: 2				
Interaction	-	Credits: 2				

	Course Objectives						
1	To impart knowledge of plate and shell behavior under different loading and boundary						
1	conditions.						
To discuss use of classical, approximate and numerical methods to solve plate and she							
2	problems.						
3	To provide knowledge of plate and shell modelling for practical applications.						
	Course Outcomes (CO)						
CO1	Illustrate the behavior of various plates and shells.						
CO2	Analyses plates and shells using different methods.						
CO3	Evaluate structural actions for practical applications of plates and shells.						

Module	Module Contents	Hours
Ι	Bending of Circular Plates Thin and Thick Plates, small and large deflection theory of thin plates - assumptions, moment-curvature relations, stress resultants, governing differential Equation for bending of plates, various boundary conditions. Bending of Circular Plates: Symmetrical loading.	6
II	Bending of Rectangular Plates Rectangular Plates Navier's and Levy's solutions for rectangular plates of various boundary conditions and subjected to various types of loads.	6
III	Finite Difference Method for Plates Finite Difference Method Solution of plate problems derivation of delta/ pattern/ stencil for biharmonic form for a rectangular mesh, two stage solutions, solution for various loadings and boundary conditions, use of symmetry & anti-symmetry, extrapolation formula, introduction to improved Finite Difference Technique.	8
IV	Introduction to Shells Shells Classification of shells based on geometry, thickness and loading. Thin shell theory, equation of shell surfaces, stress resultants, stress-displacement relations, compatibility and equilibrium equations.	6
V	Analysis of Various Shells by Membrane Theory Membrane Analysis Equation of equilibrium for synclastic and anticlastic shells under self-weight and live load, equations of equilibrium in rectangular co- ordinate system. Spherical and cylindrical shells under internal pressure, Cylindrical shells-equation of equilibrium with different directrix and shells with closed ends. Cylindrical and Hyperbolic paraboloid roofs.	8

VI	Cylindrical Shell RoofsSymmetrically loaded circular cylindrical Shell-Derivation of GoverningDifferential Equation, resembling that for beam on elastic foundation, beamtheory. Finsterwalder's Theory-Derivation of governing differential equation of8th order. D. K. J. Theory-Donnell's equation, Characteristic equation. Schorer'stheory-Derivation of differential equation.						
		D 4 1		ext Books	0 D1 - 0 - 0	~1 11 44 77 .	
1	Timoshenko. S Publishing Com		•	•	of Plates & S	Shells", Tata	McGraw-Hill
2	Ramaswamy G. Distributors, 1st		-		oncrete Shell l	Roofs", CBS I	Publishers and
	1						
				eferences			
1	Chandrashekhar Company Limit				e shells", Tat	a McGraw-H	ill Publishing
2	Flugge. W., "Str				er, Berlin, 199	90.	
	1			eful Links			
1	https://nptel.ac.i						
2	https://nptel.ac.i						
3	https://nptel.ac.i	n/courses					
	1			O Mapping			
			Prog	ramme Outco		-	
	1	2		3	4	5	6
CO1		1		2			
CO2	2			2	2		2
CO3		. 1 .	102	3		2 11: 1	2
	igth of mapping is				w, 2: Medium,	3: High.	
Each CO	of the course mus	st map to					
The second	ssment is based or	n) in ac		sessment	form of T1 /T	act 1) and T?	(Toot 2) of 20
	ssment is based of ach. Also, there sl				· · · · · · · · · · · · · · · · · · ·	,	` '
	1 and 2, T2 based						• •
	ge on modules 1 to	• -	•			ii modules wi	In nearry 5070
					, о. Гахопоту Le	vel	
Bloor	n's Taxonomy Le		T1	T2	ESE		otal
	Remember						
	Understand						
	Apply		10	10	10		30
	Analyze		5	10	15		30
	Evaluate		5		15		20
	Create				20		20
L	Total 20 20 20 100 100 100 100 100						

Walchand College of Engineering, Sangli				
	(Government Aided Autonomous Institute)			
AY 2021-22				
Course Information				
Programme M.Tech. (Structural Engineering)				
Class, Semester	First year M. Tech., Sem. II			
Course Code	5ST573			
Course Name Industrial Project				
Desired Requisites:	Design of concrete and steel structures, mechanics of structures			

Teaching Scheme		Examination Scheme (Marks)				
Lecture	-	LA1	LA2	ESE	Total	
Tutorial	-	30	30	40	100	
Practical	-		·	· · ·		
Interaction	2 Hrs/week	Credits: 2				

	Course Objectives					
1	To interact with industrial experts					
2	To learn advanced analysis software.					
3	3 To learn about making structural documents and reports.					
	Course Outcomes (CO)					
CO1	Apply advanced methods for analysis and design of structures.					
CO2	Calculate forces and displacements for special structures.					
CO3	Formulate structural drawings using advanced technique of drafting.					

Students will be asked to visit the construction industry and interact with structural consultants. Each student or group of students have to work on a special structure. The type of special structure shall be based on their interest, industrial relevance and shall have an innovative model. In case of the work in a group, the number of students in each group shall be based on the quantum of the work. They will submit the report of topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

At the end of the semester, the work completed will be assessed based on the report and presentation.

			CO-PO Map	ping			
	Programme Outcomes (PO)						
	1	2	3	4	5	6	
CO1	3					2	
CO2			2	2	3		
CO3		2				2	

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High. Each CO of the course must map to at least one PO.

	Assessment							
There are thr	There are three components of lab assessment, LA1, LA2 and Lab ESE.							
IMP: Lab ES	IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.							
Assessment Based on Conducted by Typical Schedule (for 26-week Sem) Marks								
LA1 Lab activities, Lab Course During Week 1 to Week 6				30				
	attendance,	Faculty	Marks Submission at the end of Week					

	journal		6	
LA2	Lab activities,	Lab Course During Week 7 to Week 12		30
		Faculty	Marks Submission at the end of Week	
			12	
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40
	journal	Faculty	Marks Submission at the end of Week	
			18	
considering activities/Lal drawings, pr	a 26-week semest p performance sh	ter. The actual s all include perf her suitable activ	e typical schedule of lab assessments is sho schedule shall be as per academic cale forming experiments, mini-project, pre- ities, as per the nature and requirement 8-10 experiments.	ndar. Lab sentations,

Assessment Plan based on Bloom's Taxonomy Level							
Bloom's Taxonomy Level	LA1	LA2	ESE	Total			
Remember							
Understand	10			10			
Apply	20	20	20	60			
Analyze		10	10	20			
Evaluate			10	10			
Create							
Total	30	30	40	100			

V	Valchand College of Engineering, Sangli (Government Aided Autonomous Institute)
	AY 2021-22
	Course Information
Programme	M.Tech. (Structural Engineering)
Class, Semester	First year M. Tech., Sem II
Course Code	5ST571
Course Name	Activity Based Lab- Structural Health Monitoring and Smart Materials (PC3)
Desired Requisites:	Solid Mechanics, Advanced concrete technology

Teaching Scheme		Examination Scheme (Marks)				
Lecture		LA1	LA2	ESE	Total	
Tutorial	-	30	30	40	100	
Practical	2 Hrs/week					
Interaction	-			Credits: 1		

	Course Objectives
1	To impart knowledge of smart materials.
2	To illustrate principles of structural health monitoring.
3	To provide quantitative means to assess the structural integrity loss a system undergoes after natural disasters and other hazardous events.
	Course Outcomes (CO)
CO1	Apply knowledge of smart materials and techniques to SHM

COL	Appraise structural conditions by various techniques of SHM.
(()/	Tippiuse structural containing of various teening acts of Struct

CO3 Assess civil engineering structures by SHM techniques and simulation.

Module Contents

Students will be asked to work upon **minimum two** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

viii) Visit the existing old bridge and prepare a detailed condition assessment report.

ix) Visit the existing old RC building and prepare a detailed condition assessment report. Identify structural deficiencies and suggest suitable retrofitting strategies.

x) Laboratory testing of various retrofitted elements like column, beam, slab and joints under the action of flexure, shear and axial loading.

	Textbooks								
1	Daniel Balageas, Claus - Peter Fritzenam I Alfredo Guemes, Structural Health								
1	Monitoring, Published by ISTE Ltd., UK 2006.								
2	Guidebook on Non-destructive Testing of Concrete Structures, Training course series No.								
2	17, International Atomic Energy Agency, Vienna, 2002.								
3	Gandhi, M.V., Thompson B. D., Smart Materials and Structures, ISBN 978-0-412-37010-6.								
	References								
1	Handbook on "Repair and Rehabilitation of RCC Buildings", Published by Director General,								

	CPWD, Govt. of India, 2002.
2	Handbook on Seismic Retrofitting of Buildings, Published by CPWD & Indian Building Congress in Association with IIT, Madras, Narosa Publishing House, 2008.
	Useful Links
1	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm07/
1 2	

CO-PO Mapping									
		Programme Outcomes (PO)							
	1	2	3	4	5	6			
CO1	1		3	2		2			
CO2		2				2			
CO3			2	2	2	3			

		Asse	essment	
There are thr	ee components of	lab assessment, LA	A1, LA2 and Lab ESE.	
IMP: Lab ES	E is a separate hea	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30
	attendance,	Faculty	Marks Submission at the end of Week	
	journal	-	6	
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30
		Faculty	Marks Submission at the end of Week	
		-	12	
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40
	journal	Faculty	Marks Submission at the end of Week	
	5		18	
	÷		e typical schedule of lab assessments is sho	

considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	LA1	LA2	ESE	Total
Remember				
Understand	10			10
Apply	20	20	20	60
Analyze		10	10	20
Evaluate			10	10
Create				
Total	30	30	40	100

Walchand College of Engineering, Sangli			
	(Government Aided Autonomous Institute)		
	AY 2021-22		
Course Information			
Programme	M.Tech. (Structural Engineering)		
Class, Semester	First year M. Tech., Sem. II		
Course Code	5ST572		
Course NameActivity Based Lab- Finite Element Method (PC4)			
Desired Requisites: Mechanics of structures			

Teaching	Scheme	Examination Scheme (Marks)		Marks)	
Lecture		LA1	LA2	ESE	Total
Tutorial	-	30	30	40	100
Practical	2 Hrs/week				
Interaction	-	Credits: 1			

	Course Objectives					
1	To impart knowledge of finite element method application for 1-D, 2-D,3-D elements.					
2	To discuss finite element method application in structural engineering					
3	To illustrate applications of FEM for plates, shells and structural dynamics.					
	Course Outcomes (CO)					
CO1	Implement finite element methodology for solving 1-D, 2-D, 3-D problems.					
CO2	Analyze nodal degrees of freedom and stress resultants.					
CO3	Discuss finite element model for solution of various field Problems.					

Students will be asked to work upon a minimum **four** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

- xi) Perform simple skeleton structural analysis by FE Methodology using EXCEL/Programming.
- xii) Analyse 2D/3D problems of structural mechanics using EXCEL/Programming.
- xiii) Analyse building structure for min.-3 load cases using relevant FE software.
- xiv) Analyse Industrial structure component/s for min.-3 load cases using relevant FE software.
- xv) Analyse special structure for DL+LLusing relevant FE software.
- xvi) Analyse structural dynamics problem by FE methodology using EXCEL/Programming/ relevant FE software.

	Textbooks				
1	Seshu P. N., "Finite Element Analysis", 2003.				
2	Reddy J. N., "An Introduction to the Finite Element Method" McGraw Hill, 3rd Edition, New York, 2006.				
3	3 Cook Robert D., Malkus David S., Plesha Michael E., and Witt Robert J., "Concepts and Applications of Finite Element Analysis", 2003				
	References				
1	Bathe Klaus-Jurgen, "Finite Element Procedures in Engineering Analysis",1982.				
2	Chandrupatla T. R. and Belegundu A. D., "Introduction to Finite Element in Engineering", Prentice.				
3	Zienkiewicz. O. C. & Taylor. R. L., "The Finite Element Method- Vol I & Vol II Tata				

	McGraw-HillPublishing Company Limited, 1989, 4th Edition.
	Useful Links
1	https://nptel.ac.in/courses/105/107/105107209/
2	https://nptel.ac.in/courses/105/106/105106051/
3	https://nptel.ac.in/courses/112/104/112104116/

	CO-PO Mapping					
		Programme Outcomes (PO)				
	1	2	3	4	5	6
CO1	1	2		2		
CO2		3		2		2
CO3	1		2			3

		Asse	essment		
There are thr	ee components of l	ab assessment, LA	A1, LA2 and Lab ESE.		
IMP: Lab ES	E is a separate hea	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.	
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks	
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30	
	attendance,	Faculty	Marks Submission at the end of Week		
	journal		6		
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30	
		Faculty	Marks Submission at the end of Week		
			12		
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40	
	journal	Faculty	Marks Submission at the end of Week		
18					
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown,					

considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	LA1	LA2	ESE	Total
Remember				
Understand	10			10
Apply	20	20	20	60
Analyze		10	10	20
Evaluate			10	10
Create				
Total	30	30	40	100

W	Valchand College of Engineering, Sangli	
	(Government Aided Autonomous Institute)	
	AY 2021-22	
	Course Information	
Programme M.Tech. (Structural Engineering)		
Class, Semester	First year M. Tech., Sem II	
Course Code 5ST575		
Course Name Activity based Lab- Seismic Design of Multistoried Building Lab		
Desired Requisites: Structural Dynamics and Earthquake Engineering		

Teaching	Scheme	Examination Scheme (Marks)		e (Marks)	
Lecture		LA1	LA2	ESE	Total
Tutorial	-	30	30	40	100
Practical	2 Hrs/week				
Interaction	-	Credits: 1			

		Course Objectives
	1	To provide knowledge of various concepts of earthquake resistant design of structures.
	2	To impart the knowledge of modeling and analysis of structures for displacement-based design.
	3	To illustrate seismic behavior and codal provisions for design of various earthquake resistant structures.
		Course Outcomes (CO)
(CO1	Differentiate various concepts of earthquake resistant design of structures.
0	202	Calculate response of structures for displacement and performance-based design.
0	203	Design earthquake resistant structures based on its performance.

Students will be asked to work upon **minimum two** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

xvii) Analysis and design of multi-storey buildings under seismic loading in relevant software.

xviii) Analysis and design of overhead water tank under seismic loading in relevant software.

xix) Laboratory testing of confined and unconfined concrete stations under axial, flexural loading.

xx) Prepare detail drawing in relevant software of reinforcing detailing in primary structural elements as per IS 13920-2016 code..

	Textbooks						
1	Agarwal P. and Shrikhande M., "Earthquake Resistant Design of Structures", PHI publications, New Delhi, 3 rd Edition, 2006.						
2	Key David, "Earthquake Design Practice for Buildings", Thomas Telford Publication, London,2 nd Edition, 2006.						
3	Paulay, T. and Priestley, M.J.N. "Seismic Design of Reinforced Concrete and Masonry Buildings," John Wiley & Sons, 1992.						

	References			
1	Kelly James M., "Earthquake Resistant Design with Rubber", Springer-Verlag Publication, London, 2 nd Edition, 2012.			
2	George G. Penelis and Andreas J. Kappos, "Earthquake Resistant Concrete Structures," E & FN Spon, 1997.			
3	3 FEMA-356, "Prestandard and Commentary for the Seismic Rehabilitation of Buildings, Federal Emergency management Agency, 2000.			
	Useful Links			
1	https://nptel.ac.in/courses/105/101/105101209/			
2	https://nptel.ac.in/courses/105/104/105104200/			
3	https://nptel.ac.in/courses/105/108/105108204/			
4	https://nptel.ac.in/courses/105/107/105107204/			
5	https://nptel.ac.in/courses/105/101/105101004/			

CO-PO Mapping						
			Programme C	Outcomes (PO)		
	1	2	3	4	5	6
CO1		2	2			2
CO2	1			3		2
CO3			2	2		2
The streng	th of mapping i	s to be written as	5 1.2.3: Where, 1	: Low, 2: Mediu	m, 3: High.	

Assessment								
There are thr	ee components of	lab assessment, LA	A1, LA2 and Lab ESE.					
IMP: Lab ES	E is a separate hea	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.				
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks				
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30				
	attendance,	Faculty	Marks Submission at the end of Week					
	journal	-	6					
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30				
	Faculty Marks Submission at the end of Week							
	12							
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40				
	journal	Faculty	Marks Submission at the end of Week					
	-	-	18					
Week 1 india	cates starting week	of a semester. The	e typical schedule of lab assessments is sho	own,				
considering	a 26-week semes	ster. The actual s	schedule shall be as per academic cale	endar. Lab				
activities/Lal	b performance sl	hall include per	forming experiments, mini-project, pre	esentations.				

considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level						
Bloom's Taxonomy Level	LA1	LA2	ESE	Total		
Remember						
Understand	10			10		
Apply	20	20	20	60		
Analyze		10	10	20		
Evaluate			10	10		
Create						
Total	30	30	40	100		

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
	AY 2021-22				
	Course Information				
Programme	M.Tech. (Structural Engineering)				
Class, Semester	Class, Semester First year M. Tech., Sem. II				
Course Code 5ST576					
Course Name	Activity Based Lab- Numerical Methods for Linear and Nonlinear Systems				
	Lab				
Desired Requisites:	Applied Mathematics, Structural Engineering				

Teaching Scheme		Examination Scheme (Marks)				
Lecture		LA1	LA2	ESE	Total	
Tutorial	-	30	30	40	100	
Practical	2 Hrs/week					
Interaction	-	Credits: 1				

	Course Objectives						
1	To provide knowledge of Matrix methods and statistical tools for solution of problems.						
2	To impart knowledge of numerical differentiation, integration, root finding, curve fitting and other						
2	numerical approximations.						
3	To provide exposure to field application of numerical methods in structural engineering.						
	Course Outcomes (CO)						
CO1	Execute numerical recipes for problem solving in engineering.						
CO2	Examine different numerical tools for the solution of engineering problems.						
CO3	Discuss numerical schemes for modelling and solving field applications.						

Students will be asked to work upon a minimum **four** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

- xxi) Solve problems by developing Numerical differentiation using EXCEL/Programming
- xxii) Solve problems by developing Numerical Integration using EXCEL/Programming
- xxiii) Solve Regression problem using EXCEL/Programming
- xxiv) Apply numerical method/s to field problems of static nonlinear structural analysis
- xxv) Apply numerical method/s to field problems of structural dynamic analysis.
- xxvi) Apply special numerical methods such as FDM to structural analysis of plates etc.

	Textbooks					
1	Chapra Steven and Canale Raymond, "Numerical Methods for Engineers", Mc-Graw Hill, 7th					
1	Edition, 2012.					
2	Gourdin A. and Boumhrat M., "Applied Numerical Methods", Prentice Hall India, New Delhi,					
	2000.					
3	Joe D Hoffman, "Numerical Methods for Engineers and Scientists", Marcel Dekker, 2 nd					
	Edition, 2001.					
	References					
1	Gilbert Strang, "Computational Science and Engineering", Wellesley-Cambridge Press.					
2	Gilbert Strang, "Linear Algebra and Its Applications", Wellesley Cambridge Press, 4th					

	Edition, 2009.				
3	Philips, G. M., and Taylor P. J. "Theory and Applications of Numerical Analysis", Academic				
5	Press, 2nd Edition, 1996.				
	Useful Links				
1	https://nptel.ac.in/courses/105/105/105105043/				
2	https://nptel.ac.in/courses/111/107/111107107/				
3	https://nptel.ac.in/courses/111/107/111107105/				

CO-PO Mapping									
			Programme (Dutcomes (PO)					
	1	1 2 3 4 5 6							
CO1	1		2						
CO2	1		2						
CO3	1			3		3			
The stren	The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High.								

Each CO of the course must map to at least one PO.

	Assessment						
There are thr	There are three components of lab assessment, LA1, LA2 and Lab ESE.						
IMP: Lab ES	E is a separate head	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.			
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks			
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30			
	attendance,	Faculty	Marks Submission at the end of Week				
	journal 6						
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30			
Faculty Marks Submission at the end of We							
	12						
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40			
	journal Faculty Marks Submission at the end of Week						
			18				

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	LA1	LA2	ESE	Total
Remember				
Understand	10			10
Apply	20	20	20	60
Analyze		10	10	20
Evaluate			10	10
Create				
Total	30	30	40	100

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)				
AY 2021-22				
Course Information				
Programme	M.Tech. (Structural Engineering)			
Class, Semester	First year M. Tech., Sem II			
Course Code	Course Code 5ST577			
Course Name Activity Based Lab- Design of Bridge Components Lab				
Desired Requisites:	Desired Requisites: Design of Concrete Structures			

Teaching	ing Scheme Examination Scheme (Marks)		(Marks)		
Lecture		LA1	LA2	ESE	Total
Tutorial	-	30	30	40	100
Practical	2 Hrs/week			· · ·	
Interaction	-	Credits: 1			

	Course Objectives
1	To provide knowledge of loads and analysis for different types of bridges.
2	To impart knowledge for design of different types of bridges including substructures with relevant
2	codes.
3	To provide knowledge for construction, inspection and maintenance of bridges.
	Course Outcomes (CO)
CO1	Illustrate types of bridges, their components and selection of bridge site.
CO2	Analyze various types of bridges with appropriate loads and methods.
000	

CO3 **Design** of bridges and bearings along with reinforcement details.

Module Contents

Students will be asked to work upon **minimum two** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

- xxvii) Analysis and design of deck slab and girders
- xxviii) Analysis and design of bearings
- xxix) Analysis and design of bridge piers
- xxx) Analysis and design of bridge foundation system
- xxxi) Bridge design in relevant software using relevant code

	Textbooks
1	Krishna Raju N., "Design of Bridges, Oxford and IBH Publishing Co. Ltd.", New Delhi and Kolkata, 2001.
2	Jagdeesh T. R., Jayaram M. A., "Design of Bridge Structures, Prentice Hall of India Pvt. Ltd.", New Delhi, 2003.
3	Johnson Victor, "Essentials of Bridge Engineering, Oxford and IBH Publishing Co. Ltd.", 5 th Edition, 2001.
	References
1	Raina V. K., "Concrete Bridge Practice: Construction and maintenance and rehabilitation",
	Tata Mc Graw Hill Publishing Company, New Delhi.
2	Raina V. K., "Concrete Bridge Practice: Analysis, design and economics", Tata Mc Graw Hill
	Publishing Company, New Delhi.

3	IRC Codes.
	Useful Links
1	Reinforced Concrete Road Bridges - Course (nptel.ac.in)
2	NPTEL :: Civil Engineering - NOC:Reinforced Concrete Road Bridges
3	Reinforced Concrete Road Bridges - Course (nptel.ac.in)

			CO-PO Mapp	oing		
			Programme C	Outcomes (PO)		
	1	2	3	4	5	6
CO1	1		2	3		2
CO2			2	2	1	2
CO3			2	2	1	2

		Asse	essment		
There are thr	ee components of l	ab assessment, LA	A1, LA2 and Lab ESE.		
IMP: Lab ES	E is a separate head	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.	
Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks	
LA1	Lab activities,	Lab Course	During Week 1 to Week 6	30	
	attendance,	Faculty	Marks Submission at the end of Week		
	journal		6		
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30	
		Faculty	Marks Submission at the end of Week		
			12		
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40	
	journal	Faculty	Marks Submission at the end of Week		
			18		
Week 1 indic	cates starting week	of a semester. The	e typical schedule of lab assessments is sho	own,	
considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab					
activities/Lab performance shall include performing experiments, mini-project, presentations,					
drawings, programming and other suitable activities, as per the nature and requirement of the lab					

course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	LA1	LA2	ESE	Total
Remember				
Understand	10			10
Apply	20	20	20	60
Analyze		10	10	20
Evaluate			10	10
Create				
Total	30	30	40	100

Valchand College of Engineering, Sangli				
(Government Aided Autonomous Institute)				
AY 2021-22				
Course Information				
M.Tech. (Structural Engineering)				
Class, Semester First year M. Tech., Sem. II				
Course Code 5ST578				
Course Name Activity Based Lab- Design of roof using Plate and Shell				
Desired Requisites: Theory of Elasticity and Plasticity				

Teaching	Teaching Scheme Examination Scheme (Marks)		(Marks)		
Lecture		LA1	LA1 LA2 ESE Total		
Tutorial	-	30	30	40	100
Practical	2 Hrs/week				
Interaction	-	Credits: 1			

	Course Objectives
1	To impart knowledge of plate and shell behavior under different loading and boundary conditions.
2	To discuss use of classical, approximate and numerical methods to solve plate and shell problems.
3	To provide knowledge of plate and shell modelling for practical applications.
	Course Outcomes (CO)
CO1	Illustrate the behavior of various plates and shells.
CO2	Analyses plates and shells using different methods.
CO3	Evaluate structural actions for practical applications of plates and shells.

Students will be asked to work upon **minimum two** of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

- xxxii) Assignment on bending of circular and rectangular plates
- xxxiii) Assignment on shell by membrane theory.
- xxxiv) Assignment on shell by bending theory.
- xxxv) Study of structural behaviour of plate and shell in relevant software.

Textbooks					
1	Timoshenko. S.P. And Krieger. S.W, "Theory of Plates & Shells", Tata McGraw-Hill				
	Publishing Company Limited, 2nd Edition, 1985.				
	Ramaswamy G. S., "Design and Construction of Concrete Shell Roofs", CBS Publishers and				
2	Distributors, 1st revised Edition, 1984.				
	References				
1	Chandrashekhara K., "Analysis of Thin Concrete shells", Tata McGraw-Hill Publishing				
	Company Limited, 2nd Revised Edition, 2011.				
2	Flugge. W., "Stresses in Shells", 2nd Edition, Springer, Berlin, 1990.				

Useful Links					
1	1 https://nptel.ac.in/courses/105/103/105103209/				
2	2 https://nptel.ac.in/courses/105/105/105105177/				
3	https://nptel.ac.in/courses/105/105/105105108/				

CO-PO Mapping							
	Programme Outcomes (PO)						
	1	2	3	4	5	6	
CO1		1	2				
CO2	2			2		2	
CO3	1		3			2	

Assessment					
There are thr	ee components of I	ab assessment, LA	A1, LA2 and Lab ESE.		
IMP: Lab ES	E is a separate hea	d of passing. LA1	, LA2 together is treated as In-Semester E	valuation.	
Assessment	Based onConducted byTypical Schedule (for 26-week Sem)Marks			Marks	
LA1 Lab activities,		Lab Course During Week 1 to Week 6		30	
	attendance, Facu		Marks Submission at the end of Week		
	journal		6		
LA2	Lab activities,	Lab Course	During Week 7 to Week 12	30	
		Faculty	Marks Submission at the end of Week		
			12		
Lab ESE	attendance,	Lab Course	During Week 15 to Week 18	40	
	journal	Faculty	Marks Submission at the end of Week		
	-	-	18		

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level					
Bloom's Taxonomy Level	LA1	LA2	ESE	Total	
Remember					
Understand	10			10	
Apply	20	20	20	60	
Analyze		10	10	20	
Evaluate			10	10	
Create					
Total	30	30	40	100	