

M.E. (Full Time)

Prospectus No. 131738

संत गाडगे बाबा अमरावती विद्यापीठ  
SANT GADGE BABA AMRAVATI UNIVERSITY

अभ्यासक्रमिका  
(FACULTY OF ENGINEERING & TECHNOLOGY)  
PROSPECTUS

Prescribed for  
Post Graduate Two Year Degree Course  
Master of Engineering  
(Full Time)  
Credit Grade System  
I & IInd Year Examinations 2012 - 2013 & Onwards

BRANCH  
M.E. Civil (Structural Engineering)



2012  
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Price Rs. ....../-

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**SANT GADGE BABA AMRAVATI UNIVERSITY**

**SPECIAL NOTE FOR INFORMATION OF THE STUDENTS**

- (1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.
- (2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinance Booklet the various conditions/provisions pertaining to examination as prescribed in the following Ordinances.

Ordinance No. 1	: Enrolment of Students.
Ordinance No. 2	: Admission of Students
Ordinance No. 4	: National cadet corps
Ordinance No. 6	: Examinations in General (relevant extracts)
Ordinance No. 18/2001	: An Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of deficiency of marks in a subject in all the faculties prescribed by the Statute No.18, Ordinance 2001.
Ordinance No. 9	: Conduct of Examinations (relevant extracts)
Ordinance No. 10	: Providing for Exemptions and Compartments
Ordinance No. 19	: Admission of Candidates to Degrees.

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|-------------------------|--|
| Ordinance No. 109       | : Recording of a change of name of a University student in the records of the University.  |
| Ordinance No. 6 of 2008 | : For improvement of Division/Grade.   |
| Ordinance No.19/2001    | : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001. |

**Dineshkumar Joshi**  
Registrar  
Sant Gadge Baba Amravati University

**PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM**

The pattern of question paper as per unit system will be broadly based on the following pattern.

- (1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.
- (2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.
- (3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.
- (4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60.
- (5) Each short answer type question shall contain 4 to 8 short sub question with no internal choice.

**SANT GADGE BABA AMRAVATI UNIVERSITY****DIRECTION**

No. 32/2012

Date : 18/09/2012

**Subject :- Corrigendum to Direrction No.31 of 2010, 57 of 2010 & 30 of 2012 regarding Examinations leading to the Degree of अभियांत्रिकी पारंगत (Master of Engineering) (Full Time) तंत्रशास्त्र पारंगत (Master of Technology) (Semester Pattern... Credit Grade System)**

Whereas, the Direction No.31/2010 in respect of the examinations leading to the degree of अभियांत्रिकी पारंगत ( Master of Engineering) (Full Time)/ तंत्रशास्त्र पारंगत (Master of Technology) (Full Time) (Semester Pattern.. Credit Grade System) is in existence,

AND

Whereas, the Schemes of teaching & examinations for various branches of Two Year Post Graduate Degree Course in Master of Engineering (Full Time) in the faculty of Engineering & Technology have been provided vide appendices A, B,C,D,E,F,G,H and I appended with Direction No. 31 of 2010,

AND

Whereas, the provisions for the admissions and other detailed provisions to the Degree of Master of Engineering (Full Time) are prescribed by the Direction No. 31 of 2010,

AND

Whereas, the Direction No. 30/2012 which was issued as Corrigendum to Direction No. 31 of 2010 for revised Schemes of teaching and Examinations of M.E. Civil (Structural Engg.) (Full Time) is in existence,

AND

Whereas, the proposals were received from the Principal, I.B.S.S. College of Engg., Ghatkheda, Amravati, Principal, P.R. Pote (Patil) College of Engg., Amravati, Principal, S.S.G.M. College of Engg., Shegaon, Principal, P.R.M.College of Engg. & Mngt., Badnera and H.O.D., P.G Deptt. of Computer Science, Sant Gadge Baba Amravati University, Amravati regarding starting of new course i.e. M.E. Civil (Transportation Engg.) (Full-Time), M.E. Mechanical (Thermal Engg.) (Full-Time), M.E. Mechanical Engg. (Advanced Manufacturing & Mechanical Systems Designs) (Full Time), M.E. (Electrical & Electronics Engg.) (Full Time), M.E. (Computer Science & Information Technology)(Full Time) respectively from the current Academic Session 2012-2013,

AND

Whereas, the Board of Studies in Computer Science & Engineering in its meeting held on 29.08.2012 resolved to recommend the scheme of teaching & examination, Eligibility Criteria and draft syllabus of Master of Engineering in Computer Science & Information Technology course for its implementation from the current sessiion 2012-2013 and onwards,

AND

Whereas, Hon'ble Vice Chancellor has accepted the Scheme of teaching & examination, Eligibility Criteria with correction and draft syllabus of Master of Engineering in Computer Science & Information Technology course under section 14(7) of the Maharashtra Universities Act, 1994 on behalf of the Faculty of Engineering & Technology and Academic Council,

AND

Whereas, the Management Council in its meeting held on 16.5.2012, vide item No. 175 has considered and approved the recommendations of Academic Council to start M.E. in Computer Science & I.T. in the P.G. T. Deptt. of Computer Science of Sant Gadge Baba Amravati University,

AND

Whereas, the Management Council in its meeting held on 14.08.2012, vide item No. 251 has resolved to refer the proposal for starting M.E.(Computer Science & Information Technology) Course to the Board of Studies in Computer Engineering in the faculty of Engineering & Technology, for consideration and recommendation in this respect,

AND

Whereas, the Academic Council in its meeting held on 28-8-2012 vide Item No.96 has considered and approved the Schemes of Examinations and Syllabi alongwith Eligibility Criteria for admission to M.E. Civil (Transportation Engg.) (Full-Time), M.E. Mechanical (Thermal Engg.) (Full-Time), M.E. Mechanical Engg. (Advanced Manufacturing & Mechanical Systems Designs) (Full Time), and M.E. (Electrical & Electronics Engg.) (Full Time) alongwith the corrections received from the Chairman, Board of Studies in Civil Engineering (including Construction Technology) in the revised scheme of teaching & examinations of first & second Semester of M.E.Civil (Structural) Engineering which was already approved by the Academic Council in its meeting held on 05.05.2012,

AND

Whereas, the Schemes of Examinations and Syllabi alongwith Eligibility Criteria for admission to the courses as mentioned in above paragraph are to be implemented from the current academic session 2012-2013 in phase wise manner,

AND

Whereas, admissions to the First Year of Master of Engineering (Full Time) course are to be made in the Academic Session 2012-2013,

AND

Whereas, the matter for admission of the students at the examination is required to be regulated by an Ordinance,

AND

Whereas, the Schemes of Examinations for the said courses in the faculty of Engineering & Technology are required to be regulated by the Regulation,

AND

Whereas, the process of making an Ordinance and the Regulation is likely to take some time,

AND

Whereas, the Syllabi along with the Schemes of Examinations of the above mentioned courses for Semester I & II of M.E. (Full Time) Courses are to be made available for the students admitted during the session 2012-2013,

Now, therefore, I, Dr. Mohan K. Khedkar, Vice-Chancellor of Sant Gadge Baba Amravati University, Amravati in exercise of powers conferred upon me under sub-section (8) of Section 14 of the Maharashtra Universities Act, 1994, do hereby direct as under :-

1. This Direction shall be called “ Corrigendum to Direrction No.31 of 2010, 57 of 2010 & 31 of 2012 regarding Examinations leading to the Degree of अभियांत्रिकी पारंगत (Master of Engineering) (Full Time) तंत्रशास्त्र पारंगत (Master of Technology) (Semester Pattern... Credit Grade System) Direction, 2012.”
2. This Direction shall come into force with effect from the session:
  - i) 2012-2013 for Semester -I & II and,
  - ii) 2013-2014 for Semester - III & IV
3. The Eligibility Criteria for admission to the degree of Master of Engineering (Full Time)/Master of Technology (Full Time) course shall have passed the Degree examination in Bachelor of Engineering/Bachelor of Technology in the branches mentioned under Column No.2 of the following table against the respective courses :-

TABLE

M.E./M.Tech.	B.E./B.Tech.of this University or any other statutory University/ Diploma
1.	2.
a) M.E.Civil (Transportation Engg.)	Civil/Construction Engg. Similarly Diploma holders in Civil Engg. who have completed A.M.I.E. through the Institution of Engineerins (I),Kolkata
b) M.E.Mechanical (Thermal Engg.)	Mechanical/Automobile Engg. Similarly Diploma holders in Mechanical Engg.who have completed A.M.I.E. through the Institution the Engineers(I),Kolkata.
c) M.E.Mechanical (Adv.Manufac.& Mech. Systems Design)	Mechanical/Automobile/Production/ Industrial Engg. Similarly Diploma holders in Mechanical/Production Engg.who have completed A.M.I.E. through the Institution of Engineers, (I),Kolkata.
d) M.E. (Electrical & Electronics Engg.)	Electrical Engg.,Electrical(Electronics & Power) Electrical & Electronics Engg.,Electronics Engg.,Industrial Electronics Engg., Electronics & Telecommunication Engg., Instrumentation, Electrical Power System, Biomedical Engg., Telecommunication Engg.,
e) *M.E.(Computer Science & Information Technology)	Computer Technology, Computer Engineering, Computer Science & Engg.,Electronics & Tele. Engg., Information Tech.,Electronics Engg., Electrical & Electronics Engg.,

\* The process of admission shall be as per G.R. issued from time to time by the Higher & Technical Education Department, Government of Mahrashtra, Mumbai.

4. The Schemes of Examinations for M.E. Civil (Transportation Engg.) (Full-Time), M.E. Mechanical (Thermal Engg.) (Full-Time), M.E. Mechanical Engg. (Advanced Manufacturing & Mechanical Systems Designs) (Full Time), M.E. (Electrical & Electronics Engg.) (Full Time), M.E. (Computer Science & Information Technology) (Full Time) shall be as per the appendices-A, B, C, D and E respectively, appended with this Direction.
5. Following corrections shall be carried out in Direction No. 30 of 2012:-
  - a) In Appendix, Under the Schemes of Examination of First Semester of Master of Engineering Civil (Structural Engg.) (Full-Time) -
    - (i) Under the column of "Minimum Pass Marks" the words "College assessment" shall be substituted by the word "Subject" and the figure "10" against subject Sr.No. 1 to 5 of the same column shall be substituted by the figures "50",
    - (ii) Under the column "Name of the subject", against Sr. No. 6 and 7, the word "Studio" be substituted by the word "Lab" respectively.
  - b) In Appendix, Under the Schemes of Examination of Second Semester of Master of Engineering Civil (Structural Engg.) (Full-Time) -
    - (i) Under the column of "Minimum Pass Marks" the words "College assessment" shall be substituted by the word "Subject" and the figures "10" against subject Sr.No. 1 to 5 of the same column shall be substituted by the figures "50",
    - (ii) Under the column "Name of the subject", against Sr. No. 6 and 7, the word "Studio" be substituted by the word "Lab" respectively.
6. Other related provisions of the Direction No. 31 of 2010 shall be applicable for the above mentioned courses.

Date : 18/09/2012

(Mohan K. Khedkar)  
Vice-Chancellor

**TWO YEAR POST GRADUATE DEGREE COURSE IN MASTER OF ENGINEERING (FULL TIME)**  
**CIVIL ENGINEERING (STRUCTURAL ENGINEERING)**  
**CREDIT GRADE SYSTEM**  
**FIRST SEMESTER**

S r N o.	Name Of the subject		THEORY										PRACTICAL			
			Hours/ Week			Duration (Hrs)	Credits	Max. Marks Theory Paper s	Max. Marks College assessment	Total	Min. Pass Marks		Max Mark s	Max. Marks College assessment	Total	Min Pass Mark s
			L	T	P						Theory Paper s	College assessment				
1	ISFSE1	Introduction to Earthquake And Retrofitting of structures	4	-	-	3	4	80	20	100	40	10	-	-	-	-
2	ISFSE2	Theory of Elasticity And Elastic Stability	4	-	-	3	4	80	20	100	40	10	-	-	-	-
3	ISFSE3	Matrix Methods of Structural Analysis	4	-	-	3	4	80	20	100	40	10	-	-	-	-
4	ISFSE4	Structural Dynamics	4	-	-	3	4	80	20	100	40	10	-	-	-	-
5	ISFSE5	Earthquake Resistant Design of Reinforced Concrete Structures	4	-	-	4	4	80	20	100	40	10	-	-	-	-
6	ISFSE6	Earthquake Resistant Design of Reinforced Concrete Structures - Lab	-	-	2	-	1	-	-	-	-	-	25	25	50	25
7	ISFSE7	Computer Aided Analysis & Design of Structures – Lab	-	-	2	-	2	-	-	-	-	-	25	25	50	25
		<b>TOTAL</b>	20	-	4		23			500					100	

**TOTAL : 600**

**SECOND SEMESTER**

Sr N o.	Name Of the subject		THEORY										PRACTICAL			
			Hours/ Week			Duration (Hrs)	Credits	Max. Marks Theory Papers	Max. Marks College assessment	Total	Min. Pass Marks		Max Marks	Max. Marks College assessment	Total	Min Pass Marks
			L	T	P						Theory Papers	College assessment				
1	2SFSE1	Finite Element Method	4	-	-	3	4	80	20	100	40	10	-	-	-	-
2	2SFSE2	Advanced Design of Steel Structures	4	-	-	4	4	80	20	100	40	10	-	-	-	-
3	2SFSE3	Theory of Plates and Shells	4	-	-	3	4	80	20	100	40	10	-	-	-	-
4	2SFSE4	Design of Prestressed Concrete structures	4	-	-	4	4	80	20	100	40	10	-	-	-	-
5	2SFSE5	Elective*	4	-	-	4	4	80	20	100	40	10	-	-	-	-
6	2SFSE6	Adv. Design of Steel Structures : Lab	-	-	2	-	1	-	-	-	-	-	25	25	50	25
7	2SFSE7	Design of Prestressed Concrete Structures - Lab	-	-	2	-	1	-	-	-	-	-	25	25	50	25
		<b>TOTAL</b>	20	-	4		22			500					100	

**TOTAL : 600**

**Elective\*-** (1) Substructures and Foundation Design (2) Earthquake Resistant Design of Bridges and Dams (3) Experimental Stress Analysis (4) Design of Environmental Structures

Third Semester											
Sr. No.	Subject Code	Subject	Lecture	Tutorial	Practical	Total	CREDITS		INTERNAL MARKS	TOTAL	MIM. PASSING MARKS
01	3SFSE 1	SEMINAR AND DISSERTATION	-	-	6	6	15		100	100	50
		TOTAL	-	-	6	6	15			100	
										TOTAL	100

Fourth Semester														
Sr. No.	Subject Code	Subject	Lecture	Tutorial	Practical	Total	CREDITS		EXTERNAL MARKS	INTERNAL MARKS	TOTAL	MIM. PASSING MARKS		
01	4SFSE 1	SEMINAR AND DISSERTATION	-	-	12	12	30		200	100	300	150		
		TOTAL	-	-	12	12	30				300			
												TOTAL		300
GRAND TOTAL 1600														

#### Semester III

Seminar : Seminar to be delivered on work completed during third semester. 50 internal marks out of 100 will be assessed by a Committee consisting of Head of Department, dissertation guide and subject expert appointed by Principal of the College / Head of University Department. Remaining 50 internal marks will be given by guide based on performance.

Dissertation : Title of the dissertation work to be submitted to the University on or before 15th Sept. (for regular examination) and 15th of February (for supplementary exam.).

#### Semester IV

Seminar : to be delivered on the complete work of dissertation. 50 internal marks out of 100 will be assessed by a Committee consisting of Head of Department, dissertation guide and subject expert appointed by Principal of the College / Head of University Department. Remaining 50 internal marks will be given by guide based on performance.

**Note** : Thesis of dissertation work must be submitted to the University on or before 30th April (for regular exam. ) and 30th November ( for supplementary exam.). Thesis of Dissertation work be submitted with late fee to the University upto 31 May (for regular exam.) and 31st December (for supplementary exam.). The late fee shall be charged as in case of Examination form.

**Notes** : 1. Student should fill the examination form in the beginning of III semester jointly for III & IV semester.

2. Single marksheet for III & IV semester together will be given to the student.

**SYLLABUS PRESCRIBED FOR  
TWO YEAR P.G. DEGREE COURSE IN M.E. (F.T.)  
M.E. CIVIL (STRUCTURAL ENGINEERING)**

**SEMESTER I**

**1SFSE1: INTRODUCTION TO EARTHQUAKE AND  
RETROFITTING OF STRUCTURES**

- Unit I:** Interior of earth, Engineering geology of earthquakes, plate tectonics, Seismicity of the world, tectonic features of India, Faults, Propagation of earthquake waves, Quantification of earthquake (magnitude, energy, intensity of earthquake), Measurements of earthquake (Accelerograph, Accelerogram recording), Determination of magnitude, Epicenter distance, focal depth, etc. Ground motion and their characteristics, Factors affecting ground motions, Guidelines for achieving efficient seismic resistant planning, selection of sites, importance of architectural features in earthquake resistant buildings, continuity of construction, Projection & suspended parts, special construction features like separation of adjoining structure, Crumble section, Stair case etc, Twisting of building, seismic effects on structures, inertia forces, horizontal & vertical shaking.
- Unit II:** Non-Engineered structures: Behavior of masonry structure during earthquake, bands & reinforcement in masonry building, openings in wall, importance of flexible structures.
- Unit III:** Concept of earthquake Resistant design, design philosophy, four virtues of EQRD: Stiffness, Strength, ductility and Configurations.
- Unit IV:** Principles of Repairs and Retrofitting, Terminology in Repairs, Restoration, Strengthening and Rehabilitation, Criteria for Repairs, Restoration and Retrofitting; Repair Materials; In-situ testing methods for RC and masonry structures; Seismic Hazard Evaluation; Techniques of repair and retrofitting of masonry buildings; Seismic evaluation of RC building-Demand capacity method, Pushover analysis and performance based approach; Techniques of Repair and Retrofitting in RC buildings; Retrofitting of buildings by seismic base isolation and supplemental damping; One case study in retrofitting.

**Reference Books:**

1. Wakabayshi M.; Design of Earthquake Resistant Buildings, McGraw Hill Books Company; 1986

2. Okamoto, S.; Introduction to Earthquake Engineering; University of Tokyo press; 2nd Edition; 1984
3. Kramer, S.L.; Geotechnical Earthquake Engineering; Prentice Hall; New Jersey; 1996
4. Bolt, B.A.; Earthquakes; W. H. Freeman & Company; NY; 198
5. Amita Sinhal, Understanding Earthquake Disasters, Tata Mcraw-Hill Publishing Company Ltd.
6. P. N. Agrawal, Engineering Seismology, Oxford & IBH Publishing Co Pvt .Ltd
7. Pankaj Agrawal & Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall India.
8. Duggal S. K., Earthquake Resistant Design of Structures, Oxford University Press 2007

**1SFSE2: THEORY OF ELASTICITY AND ELASTIC STABILITY**

- Unit I:** 3D-cartesian: Elastic structure subjected to loads, body forces, surface forces, components of displacement, strain and stress at a point of 3D structure, Generalised Hookes law, isotropic, orthotropic material, stresses in terms of strains and vice-versa, stress equilibrium equations, boundary conditions, strain-displacement relations, principal stresses and principal planes, elastic constants.
- Unit II:** 2D-cartesian: Plane stress and plane strain conditions, stress-strain relations, strain displacement relations, strain-compatibility condition, stress-compatibility condition, bi-harmonic equilibrium equation, Airy stress function, principal stresses and strains.]
- Unit III:** Saint Venant principle, solution of simple problems in tension, bending, torsion, plate with small circular hole under tension.
- Unit IV:** Concept of stability, stable, unstable and neutral equilibrium, energy criteria, method of stability analysis.
- Unit V:** Elastic buckling of columns, buckling of continuous beams, buckling of frames, neutral equilibrium method, matrix approach, moment distribution method.  
Buckling of thin rectangular plates.

**Reference Books:**

1. Timoshenko S. P., Theory of Elasticity, Tata McGraw Hill.
2. Timoshenko S. P. and Gere J. N., Theory of Elastic stability Tata McGraw Hill.
3. Alexander Chajes, Principle of Structural Stability.



**1SFSE3: MATRIX METHODS OF STRUCTURAL ANALYSIS**

- Unit I :** Flexibility method(structural approach), flexibility coefficients, generalized flexibility coefficients, static degree of indeterminacy, basic determinate structure, redundant, alternate choices of redundant and corresponding primary structures, matrix formulation, hand solution of simple problem on truss, beams, frames, grids up to three unknown.
- Unit II :** Stiffness method(structural approach), stiffness coefficient, generalized stiffness coefficients, kinematic degree of indeterminacy, unknown joint displacements for various structures, joint equilibrium equations, hand solution for simple problems of beams, frames, trusses up to three unknowns.
- Unit III :** Stiffness method(member approach), general strategy, member and structure coordinate system, force-displacement relations in member coordinates, member stiffness matrix, transformation of displacements and forces from member to structure coordinates and vice-versa, stiffness matrix referred to structure coordinate system, joint equilibrium equations using assembly procedure, large structures, boundary conditions. Application to beams, plane and space trusses, plane and space frames and grids. Programming aspects, flow charts, solution of equations, member end forces, free body diagram of members
- Unit IV :** Memory problems, in-core solution techniques, assembly of stiffness matrix in full form, half band form and sky line storage, half band width, column height, diagonal address.
- Unit V :** Data preparation for solution of structures by stiffness method(member approach), alternatives for data preparation, displacement codes, joint-displacement and element displacement code relations.

**Reference Books:**

1. Pandit G.S. and Gupta S.P., Structural Analysis A matrix approach, Tata Mc Graw Hill, New Delhi 1986
2. Gere J.M. and W.Weaver, Analysis of framed Structures, D.Van Nostrand com. Inc.,Affiliated East West Press, 1965
3. Meghre A.S. and Deshmukh S.K., Matrix Methods of Structural Analysis, Charotar Publishing, Anand, India 2003.

**1SFSE4: STRUCTURAL DYNAMICS**

- Unit I :** Sources of vibration, types of excitations, Spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle, Single degree of freedom systems; Mathematical model of physical systems; free vibrations, damped free vibrations, critical damping, and response, periodic loading expressed in harmonics, dynamic load factor.
- Unit II :** Single degree freedom system, response to impulsive loading, rectangular, triangular pulses, Duhamel Integral. Response to general dynamic loading, Numerical schemes such as Wilson-Theta, Newmark-Beta, constant linear acceleration & time domain and frequency domain analysis.
- Unit III :** Multi-degree freedom system, stiffness and flexibility approaches, Lumped-mass matrix, free vibrations fundamental Frequencies and mode shapes, orthogonality of, response to dynamic loading, Formulations of equations of motion, mode superposition method, modal matrix, numerical scheme of iteration method.
- Unit IV :** Vibration of Continuous Systems: Free vibrations of Continuous systems-axial and transverse vibration of bars / beams. Response of continuous systems to dynamic loads. Rayleigh-Ritz method.
- Unit V :** Structural response to earthquake, Response spectrum design earth quake, IS code provisions for multistory frames.

**Reference Books:**

- 1 Chopra, A. K.; Dynamics of Structures; Prentice Hall; 1995
- 2 Clough, R.W.; & Penzin, J.; Dynamics of Structures; McGraw Hill; 1993
- 3 Humar J. L.; Dynamics of Structures; Prentice Hall; 1990
- 4 Mario, Paz; Structural Dynamics; CBS Publ.; N-Delhi; 1995
- 5 Timoshenko, S.; Advanced Dynamics; McGraw Hill Book Co; NY; 1948
- 6 Meirovitch L.; Elements of Vibration Analysis; 2<sup>nd</sup> Edition; McGraw Hill International Edition; Singapore; 1986
- 7 Biggs, J.M.; Introduction to Structural Dynamics; McGraw Hill; NY; 1964

### 1SFSE5: EARTHQUAKE RESISTANT DESIGN OF REINFORCED CONCRETE STRUCTURES

- Unit I :** Review of Limit State Design of RC members. Confinement of concrete Philosophy of earthquake resistant design, Ductility, Redundancy & Over strength, Damping, Supplemental Damping, Base Isolation, Codal Provisions. Seismic behaviour of concrete,  
Beams (Flexural, Shear and torsion)  
Uni-axial and biaxial Beam-column (Axial, shear and moments)
- Unit II:** Building frames, frame-shear wall buildings, Braced Buildings, Preliminary sizing and Mathematical modeling of buildings with different structural systems with and without diaphragms, Earthquake, wind and other (i.e. blast, snow) load calculations along with dead load and live loads and their combinations.
- Unit III:** Special aspects in Multi-storied buildings: Effect of torsion, flexible first story, P-delta effect, effect of soil-structure interaction on building response, drift limitation.

Analysis and Design of multi-storied buildings with masonry infill,

#### Reference Books:

1. Paulay T. and Prestiley M.J.N.; Seismic design of R C & Masonry Buildings; John Wiley & Sons; 2<sup>nd</sup> Edition; 1999
2. Booth, E.; Concrete Structures in Earthquake Regions; Longman Higher Education; 1994
3. Raynolds C.E.; Reinforced Concrete Design Handbook; 9<sup>th</sup> Edition; Rupa & Company; Calcutta; 1981
4. Raynolds, C.E.; Basic Reinforced Concrete Design; Vol.-II; Conc. Publications Ltd.; 1962
5. Fintel M.; Handbook of Concrete Engineering; 2<sup>nd</sup> Edition; CBS Publishers, Delhi; 1986
6. Park and Paulay; Reinforced Concrete Structures, John Wiley and Sons
7. Duggal S. K., Earthquake Resistant Design of Structures, Oxford University Press 2007

### 1SFSE6: EARTHQUAKE RESISTANT DESIGN OF REINFORCED CONCRETE STRUCTURES: LAB

Complete Design calculations and Drawings to be developed for a multi-storied building based on the above syllabus.

### 1SFSE7: COMPUTER AIDED ANALYSIS & DESIGN OF STRUCTURES: LAB

- Introduction to Computer systems and facilities. Operating systems, Software, Software development processes.

-Introduction to software packages like STAADPRO, STRUDS, SAP-2000, Etab and ANSYS

### SEMESTER II

#### 2SFSE1: FINITE ELEMENT METHOD

- Unit I :** Continuum structure, discretisation, nodes and elements, minimum potential energy theorem, relation to Rayleigh- Ritz method Interpolation, shape functions, one dimensional Lagrangian and first order Hermitian functions, Natural or local coordinate, Two dimensional shape functions, Lagrangian and Serendipity shapes, Area and volume coordinates.
- Unit II:** Two dimensional plane stress and plane strain analysis, constant strain triangle, linear strain triangle, rectangle, stiffness matrix, nodal load matrix due to body forces.
- Unit III:** Isoparametric elements, plane stress/strain analysis, coordinate and derivative transformation, formulations for four and eight noded element, extrapolation of stress, Gauss integration, locations and weightages of Gauss points.  
Three dimensional stress analysis using eight and twenty noded isoparametric hexahedron, four noded tetrahedron.  
Ring type element for analysis of axisymmetric solids subjected to axisymmetric loads only  
Thin plate bending element, C<sup>1</sup> continuity, 12 d.o.f. ACM element, 16 d.o.f. Bogner Fox element.  
Thin shallow shells, cylindrical shell, axisymmetrical shell subjected to axisymmetric loads only, Conical frustum element.

Plate bending elements for Mindlin plates,  $C^0$  continuity, four eight and nine noded isoparametric element, nodal loads due to transverse load on element.

Convergence, different types of convergence trends, condition for convergence, geometric isoparametry, continuity of displacement and derivatives along element edge.

Programming aspects, geometry, connectivity, code number, alternate data types, half band, data preparation, flow chart, typical subroutines for assembly, shape functions, stiffness matrix solution of equation.

#### Reference Books:

1. O. C. Zienkiewing and R. L. Taylor, The finite element method, Vol.1 and 2, Mc Graw Hills.
2. C.S.Krishnamoorthy, Finite Element Analysis, Theory and Programming., Tata Mc Graw Hills 1994
3. R. D. Cook, Concept and application of finite element analysis, John Willey and Sons.
4. Bathe and Wilson, Numerical Methods of Structural analysis
5. E.Hinton and D.R.J. Owen, Finite Element programming, Academic press
6. A.D. Belegunda and T.R.Chandrupatla, Finite element method in engineering, pretile Hall

### 2SFSE 2: ADVANCED DESIGN OF STEEL STRUCTURES

**Unit I :** Introduction to Allowable Stress Design, Plastic design, Limit state Design Loadings as per IRC, IS (IS: 800-2007, IS: 875 part 1-V, IS: 1893) applicable to various steel structures.  
Welded and riveted connections.  
Design of Beams, Beam-column, Plate Girders.  
Industrial Buildings including crane girders.  
Design of Foot Bridge and Introduction to Composite structures.  
Analysis and Design of Multistory building subjected to Seismic and Wind forces

#### Reference Books:

1. Owens, G.W. & Knowles, P.R.; Steel Designers Manual; Blackwell; 1994
2. Gaylord E.H. & Gaylord, C. N.; Design of Steel Structures; McGraw Hill Publ.1998

3. Steel Design Manual; ELBS and Granada Publishers; London
4. Johnson, R.P.; Composite Structures of Steel and Concrete; Volume-I; Granada Publishing Ltd.; London; 1975
5. Salmon and Johnson; Steel Structures – Design and Behaviour, Harper and Collins Publishers.
6. Subramanian N., Design of Steel Structures, Oxford University Press 2008
7. IS 800-2007, BIS
8. Duggal S.K., Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited.
9. Bavikatti S.S., Design of Steel Structures By Limit State Method As Per IS:800-2007, I.K. International Publishing House Pvt. Ltd.
10. Subramanian N., Steel Structures Design and Practice, Oxford University Press 2008

### 2SFSE3: THEORY OF PLATES AND SHELLS

**Unit I :** Governing differential equations of thin rectangular Plates with various boundary conditions and loadings.

Introduction, Moment of curvature relation in pure bending, metrical bending of circular plates (Lateral loaded, uniformly loaded with clamped)

Laterally loaded rectangular plates, Differential equation of the deflection surface (Lagrange's equation), Boundary conditions, simply supported plates under sinusoidal loading, Navier's solution.

Finite differential method, differential equation to bent surface of anisotropic plate, Application to grid.

General shell geometry, classifications, stress resultants, equilibrium equation, Membrane theory for family of shells (Parabolic, Quaternary, Cycloid, Circular, hyperbolic).

Classical bending theories of cylindrical shells with and without edge beams, Finster Walder Theory, Schorer's Theory

Approximate analysis & design of cylindrical shells.

#### Reference Books:

1. Timoshenko, S. P. & Kriegar, W.; Theory of Plates & Shells; McGraw Hill; NY; 1970

2. Szilard, R.; Theory and Analysis of Plates; Prentice Hall; 1974
3. Novozhilov, V.V.; Thin Shells; Noordhoff of Groningen; 1964
4. Ramaswamy G. S., Design of Concrete Shells; Krieger Publication Co.; 1984
5. Chandrasekhar K.; Theory of Plates; University Press India Ltd.; Hyderabad; 1<sup>st</sup> Edition; 2001

#### **2SFSE4: DESIGN OF PRESTRESSED CONCRETE STRUCTURES**

1. Introduction to pre-stressing, Analysis for pre-stress, Load balancing.
2. Partial pre-stressing, Grouting of beams, fire resistance of beams, special problems like stress corrosion, fatigue under dynamic loading etc.
3. Basic design for flexure (Type I structures), Introduction to Limit state method.
4. Limit state of collapse: Shear, Bond, deflection & cracking in pre-stressed concrete member
5. Comprehensive design of a rectangular and/or a T-section by limit state method.
6. Design of Poles, Piles and Sleepers.
7. Design and analysis of pre-stressed concrete pipes and circular tank.
8. Analysis and design of end block.
9. Comprehensive design of post-tensioned girders.
10. Analysis and design of continuous beams up to two spans linear transformation, concordant cable.
11. Analysis and design of portal frame, single storey and limited to two bays.

#### **Reference Books:**

1. Krishna Raju, N.; Prestressed Concrete Structures; TMH; Delhi; 1981
2. Lin, T.Y. and Burns, N.H.; Design of Prestressed Concrete Structures; 3<sup>rd</sup> Edition; John Wiley & Sons; NY; 1981
3. Ashok Jain, R. C. C. Design
4. P. Dayaratnam, Prestressed Concrete Structures, Oxford & IBH
5. Latest relevant BIS codes

#### **2SFSE5 : Elective: (1) SUBSTRUCTURES AND FOUNDATION DESIGN**

Analysis and design of Piers, Abutments and Retaining walls.

Shallow foundations: Individual and combined footings for axial and bending loads (Uniaxial and biaxial), Loss of contacts.

Rafts, Annular Footings, Rigid and flexible foundations, Beams and slabs on elastic foundations.

Deep Foundations: Piles and Wells foundations.

Design of Machine Foundations.

#### **Reference Books:**

1. Hetenyi M.; Beam on Elastic foundation; University of Michigan Press; 1946
2. Bowles, J. E.; Foundation Analysis & Design; McGraw Hill; 5<sup>th</sup> Edition; 1996
3. Swami Saran; Soil Dynamics and Machine Foundations, Galgotia Publications (P) Ltd, New Delhi, 1999
4. Srinivasulu P, Vaidyanathan C V ; Handbook of Machine Foundation
5. Kurian N P; Modern Foundations – Introduction to advanced Techniques

#### **2SFSE5: Elective: (2) EARTHQUAKE RESISTANT DESIGN OF BRIDGES AND DAMS**

**Bridges:** Performance in past earthquakes, Types of bridge superstructure and introduction to their design, sub-structure, bearings, IRC / IRS Bridge loadings and other codal recommendations, Performance of Bridges in past earthquakes.

Seismic design philosophy for Bridges, State of art Modeling of bridges, Seismic Design of Substructures, Capacity design of substructures and ductile detailing,

Seismic design of well and pile foundations

**Dams:** Performance of concrete and masonry gravity dams, seismic design considerations, dynamic analysis of dams. Dam-foundation-reservoir interaction, bending, shear and finite element method of analysis.

**Reference Books:**

1. Chen W.F. and Duan L., Bridge engineering Handbook; CRC Press; 1999
2. Fintel, M.; Handbook of Concrete Engineering; 2<sup>nd</sup> Edition; CBS Publishers Delhi; 1986

**2SFSE5: Elective: (3) EXPERIMENTAL STRESS ANALYSIS**

Photo elasticity: stress analysis by photo elasticity, light, polarization of light, Polariscopes, plane polariscopes, circular polariscopes, fringes, optics of polariscopes, stress-optic law, isoclinics and isochromatics.

D-photoelasticity, compensators and compensation technique, separation of principal stresses, analytical and experimental methods, typical model studies.

3D techniques, stress freezing, scattered light technique.

Stress analysis by strain measurement, mechanical, optical, acoustical strain gauges, strain gradients.

Electrical resistant strain gauges, various types, mounting of gauges, Rosette and rosette analysis, gauge factor, Wheatstone bridge, temperature compensation. Strain recording instruments, bridge configuration, and sensitivity,

Model analysis, direct and indirect methods, prototype and model similarities, dimensional analysis, influence lines, beams and other deformers.

Brittle coating method

Refringent coating method

Moiré fringe method

**Reference Books:**

1. Dally And Rally, Experimental Stress Analysis, McGraw Hill.
2. M-Frocht, Photoelasticity, John Wiley
3. Bungy S., Testing Of Concrete In Structure, Surrey University Press.

**2SFSE5: Elective: (4) DESIGN OF ENVIRONMENTAL STRUCTURE**

1. Analysis and design of cylindrical shaped E.S.R, supported peripherally & internally making the tank floor a solid continuous slab system, Analysis and design of staging.
2. Design of underground water tanks, swimming pools, Jacks well
3. Design of Water Treatment Plant units, aeration tank, Clari-floculator, flash mixers.
4. Design of water sumps, filters, Design of digestion tank.

**Reference Books:**

1. Paulay T. & Park R.; Reinforced Concrete structures; John Wiley & Sons
2. Krishna Raju N., Advanced R.C.C. Design, Tata McGraw Hill, New Delhi
3. Reynolds C.E.; Reinforced Concrete Design Handbook; 9<sup>th</sup> Edition; Rupa & Company; Calcutta; 1981
4. Punmia B. C., R. C. C. Design, Laxmi publications
5. Datta N. P., Waste Water Treatment, Oxford & IBH Publication

**2SFSE6 ADVANCED DESIGN OF STEEL STRUCTURES : LAB**

Complete Design calculations and Drawings to be developed for the following structures based on syllabus For the relevant theory subject (2SFSE2)

1. Design of a steel bridge
2. Design of an Industrial shed

**2SFSE7 DESIGN OF PRESTRESSED CONCRETE STRUCTURES : LAB**

Complete Design calculations and Drawings to be developed for the following structures based on syllabus For the relevant theory subject (2SFSE4)

1. Comprehensive design of a pre-tensioned Pole
2. Comprehensive design of a post-tensioned Girder
3. Field visit report

**3SFSE1 & 4SFSE1 SEMINAR AND DISSERTATION**

A Dissertation on Recent Trends in Structural Engineering to be submitted.  
Marks shall be based on Seminar, dissertation. and Viva-Voce on  
dissertation.

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