ACADEMIC REGULATIONS COURSE STRUCTURE AND DETAILED SYLLABUS

CIVIL ENGINEERING

For

M. Tech. (Structural Engineering)

Three Year **Part Time** Programme)

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(Autonomous)
Kukatpally, Hyderabad – 500 085, Telangana, India.

2016

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
Kukatpally, Hyderabad – 500 085

ACADEMIC REGULATIONS 2015
for CBCS Based M.Tech. (Part- Time) Programmes
(Effective for the students admitted into I year from the Academic Year **2016-17** and onwards)

1.0 Part-Time Post-Graduate Degree Programmes in Engineering & Technology (PTPGP in E & T):

JNTUH offers 3 Year (6 Semesters) Part-time **Master of Technology** (M.Tech.) Degree Programmes, under Choice Based Credit System (CBCS) at its Constituent Autonomous College - JNTUH College of Engineering Hyderabad with effect from the Academic Year 2016 - 17 onwards in the different branches of Engineering & Technology with different specializations.

2.0 Eligibility for Admission:

2.1 Admissions to the PTPGPs shall be made subject to the eligibility, qualifications and specializations prescribed by JNTUH College of Engineering Hyderabad, JNT University Hyderabad, for each Specialization under each M.Tech. Programme, from time to time.

2.2 Admission to the PTPGP shall be made either on the basis of the Merit Rank obtained by the qualifying candidate at an Entrance Test conducted by the Jawaharlal Nehru Technological University Hyderabad / on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the Government from time to time.

2.3 Candidates seeking admission to programmes on a part time basis should be working in or around the place where the programme is being run after passing the qualifying examination.

2.4 The medium of instructions for all PG Programmes will be ENGLISH only.

3.0 M.Tech. Programme (PTPGP in E & T) Structure:

3.1 The M.Tech. Programmes in E & T of JNTUH-CEH are of Semester Pattern, with 6 Semesters constituting 3 Academic Years, each Academic Year having TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

3.2 UGC/ AICTE specified Definitions/ Descriptions are adopted appropriately for various terms and abbreviations used in these PTPGP - Academic Regulations.

3.2.1 **Semester Scheme:**

Each Semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab Course', or 'Design/ Drawing Subject', or 'Seminar', or 'Comprehensive Viva', or 'Project', as the case may be.

3.2.2 **Credit Courses:**

All Subjects (or Courses) are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a L: T: P: C (Lecture Periods: Tutorial Periods: Practicals Periods : Credits) Structure, based on the following general pattern …

- One hour/ Week/ Semester for Theory/ Lecture (L) Courses; and,
- Two hours/ Week/ Semester for Laboratory/ Practical (P) Courses or Tutorials (T).

Other student activities like Study Tour, Guest Lecture, Conference/ Workshop Participations, Technical Paper Presentations etc., and identified Mandatory Courses if any, will not carry Credits.

3.2.3 **Subject/ Course Classification:**

All Subjects/ Courses offered for the PTPGP are broadly classified as : (a) Core Courses (CoC), and (b) Elective Courses (EℓC).

- Core Courses (CoC) and Elective Courses (EℓC) are categorized as PS (Professional Subjects), which are further subdivided as – (i) PC (Professional/ Departmental Core) Subjects, (ii) PE (Professional/ Departmental Electives) , (iii) Seminar, (iv) Comprehensive Viva, and (v) Project Work (PW).

3.2.4 **Course Nomenclature:**

The Curriculum Nomenclature or Course-Structure Grouping for the M.Tech. Degree Programmes is as listed below …

S. No.	***Broad Course Classification***	***Course Group/ Category***	***Courses Description***	***Credits***
1)	Core Courses (CoC)	PC- Professional Core	Includes core subjects related to the Parent Discipline/ Department/ Branch of Engg.	20
2)	Elective Courses (EℓC)	PE– Professional Electives	Includes Elective subjects related to the Parent Discipline/ Department/ Branch of Engg.	32
3)	Core Courses	Project Work	M.Tech. Project or PG Project or PG Major Project	30
		Seminar	Seminar/ Colloquium based on core contents related to Parent Discipline/ Department/ Branch of Engg.	2
		Comprehensive Viva-voce	Viva-voce covering all the PG Subjects and related aspects	4
		Communication Skills/ Soft Skills	Lab oriented	2
Total Credits for PTPGP				**90**

4.0 Course Work:

4.1 A Student, after securing admission, shall pursue and complete the M.Tech. PTPGP in a minimum period of 3 Academic Years (6 Semesters), and within a maximum period of 6 Academic Years (starting from the Date of Commencement of I Year).

4.2 Each student shall Register for and Secure the specified number of Credits required for the completion of the PTPGP and Award of the M.Tech. Degree in respective Branch of Engineering with the chosen Specialization.

4.3 I &II Year is structured to provide typically 14 Credits (14 C) in each of the I and II Semesters, and III Year comprises of 34 Credits (34 C), totaling to 90 Credits (90 C) for the entire M.Tech. Programme.

5.0 Course Registration:

5.1 A 'Faculty Advisor' shall be assigned to each M.Tech. Programme with respective Specialization, who will advise the Students about the M.Tech. Programme Specialization, its Course Structure and Curriculum, Choice/ Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

5.2 A Student may be permitted to Register for Subjects/ Courses of 'his CHOICE' with a typical total of 14 Credits per Semester in I &II Year (Minimum being 10 C and Maximum being 18 C, and 16 Credits (inclusive of Project) per V Semester in III Year (Minimum being 16 C and Maximum being 30 C), 18 credits (inclusive of Project) per VI Semester in III Year (minimum being 18 C and maximum 32 C), based on his interest, competence, progress, and 'PRE-REQUISITES' as indicated for various Subjects/ Courses, in the Department Course Structure (for the relevant Specialization) and Syllabus contents for various Subjects/ Courses.

5.3 Choice for 'additional Subjects/ Courses' in any Semester (above the typical 14/16/18 Credit norm, and within the Maximum Permissible Limit of 16/30/32 Credits, during I&II/ III Years as applicable) must be clearly indicated in the Registration, which needs the specific approval and signature of the Faculty Advisor/ Counselor on hard-copy.

5.4 Dropping of Subjects/ Courses in any Semester of I Year or II year may be permitted, ONLY AFTER obtaining prior approval and signature from the Faculty Advisor (subject to retaining a minimum of 10 Credits), 'within 15 Days of Time' from the beginning of the current Semester.

6.0 Subjects/Courses to be offered

6.1 A typical Section(or Class) sanctioned strength for each semester shall be 30.

6.2 A Subject/Course may be offered to the students ONLY if Minimum of 15 (1/2 of Section Strength) opt for the same. The Maximum strength of a Section is limited to 45(30+1/2 of the Section Strength).

7.0 Attendance Requirements:

7.1 A Student shall be eligible to appear for the End Semester Examination (SEE) of any Subject, if he acquires a minimum of 75% of attendance in that Subject for that Semester.

7.2 A Student's Seminar Report and Seminar Presentation shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar Presentation Classes during that Semester.

7.3 Condoning of shortage of attendance up to 10% (65% and above, and below 75%) in each Subject or Seminar of a Semester may be granted by the College Academic Council on genuine and valid grounds, based on the Student's representation with supporting evidence.

7.4 A stipulated fee per Subject/Seminar shall be payable towards condoning of shortage of attendance.

7.5 Shortage of Attendance below 65% in any Subject/Seminar shall in NO case be condoned.

7.6 A Student, whose shortage of attendance is not condoned in any Subject(s) or Seminar in any Semester, is considered as 'Detained in that Subject(s)/ Seminar', and is not eligible to take End Examination(s) of such Subject(s) (and in case of Seminars, his Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he has to seek Re-registration for those Subject(s)/Seminar in subsequent Semesters, and attend the same as and when offered.

8.0 Academic Requirements:

The following Academic Requirements have to be satisfied, in addition to the Attendance Requirements mentioned in Item No. 7**.**

8.1 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course, if he secures not less than 40% Marks (28 out of 70 Marks) in the End Semester Examination, and a minimum of 50% of Marks in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing B Grade or above in that Subject.

8.2 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to - Seminar, and Comprehensive Viva-voce, if he secures not less than 50% of the total Marks to be awarded for each. The Student would be treated as failed, if he - (i) does not attend the Comprehensive Viva-voce as per the schedule given, or (ii) does not present the Seminar as required, or (ii) secures less than 50% of Marks (< 50 Marks) in -Seminar/ Comprehensive Viva-voce evaluations.
He may reappear for comprehensive viva where it is scheduled again; For seminar, he has to reappear in the next subsequent Semesters, as and when scheduled.

8.3 A Student shall - register for all Subjects covering 90 Credits as specified and listed in the Course Structure for the chosen PTPGP Specialization, put up all the Attendance and Academic requirements for securing 90 Credits

obtaining a minimum of B Grade or above in each Subject, and 'earn all 90 Credits securing SGPA $\geq$ 6.0 (in each Semester) and final CGPA (ie., CGPA at the end of PTPGP) $\geq$ 6.0, to successfully complete the PTPGP.

8.4 Marks and Letter Grades obtained in all those Subjects covering the above specified 90 Credits alone shall be considered for the calculation of final CGPA, which shall be indicated in the Grade Card of III Year II Semester.

8.5 If a student registers for some more 'extra Subjects' (in the parent Department or other Departments/Branches of Engg.) other than those listed Subjects totaling to 90 Credits as specified in the Course Structure, the performances in those 'extra Subjects' (although evaluated and graded using the same procedure as that of the required 90 Credits) will not be taken into account while calculating the SGPA and CGPA. For such 'extra Subjects' registered, % marks and Letter Grade alone will be indicated in the Grade Card, as a performance measure, subject to completion of the Attendance and Academic Requirements as stated in Items 7 and 8.1 – 8.4 above.

8.6 Students who fail to earn 90 Credits as per the specified Course Structure, and as indicated above, within 6 Academic Years from the Date of Commencement of their I Year, shall forfeit their seats in M.Tech. Programme and their admissions shall stand cancelled.

8.7 When a Student is detained due to shortage of attendance in any Subject(s)/Seminar in any Semester, no Grade Allotment will be done for such Subject(s)/Seminar, and SGPA/ CGPA calculations of that Semester will not include the performance evaluations of such Subject(s)/Seminar in which he got detained. However, he becomes eligible for re-registration of such Subject(s)/Seminar (in which he got detained) in the subsequent Semester(s), as and when next offered, with the Academic Regulations of the Batch into which he gets readmitted, by paying the stipulated fees per Subject. In all these re-registration cases, the Student shall have to secure a fresh set of Internal Marks (CIE) and End Semester Examination Marks (SEE) for performance evaluation in such Subject(s), and subsequent SGPA/ CGPA calculations.

8.8 A Student eligible to appear in the End Semester Examination in any Subject, but absent at it or failed (failing to secure B Grade or above), may reappear for that Subject at the supplementary examination (SEE) as and when conducted. In such cases, his Internal Marks (CIE) assessed earlier for that Subject/ Course will be carried over, and added to the marks to be obtained in the supplementary examination (SEE), for evaluating his performance in that Subject.

9.0 Evaluation - Distribution and Weightage of Marks:

9.1 The performance of a Student in each Semester shall be evaluated Subject-wise (irrespective of Credits assigned) with a maximum of 100 Marks for Theory or Practicals or Seminar or Drawing/Design or Comprehensive Viva-voce etc; however, the M.Tech. Project Work (Major Project) will be evaluated for 200 Marks.

9.2 a) For Theory Subjects, CIE Marks shall comprise of - Mid-Term Examination Marks (for 25 Marks), and Assignment Marks (for 5 Marks).

b) During the Semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 25 Marks (with 120 minutes duration). The better performance out of these two Mid-Term Examinations shall be considered for the award of 25 Marks.

9.3 For Practical Subjects, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 Internal Marks, and 70 Marks are assigned for Lab./Practicals End Semester Examination (SEE). Out of the 30 Marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 Marks; and the performance in an internal Lab./Practical Test shall be evaluated for 10 marks. The SEE for Lab./ Practicals shall be conducted at the end of the Semester by the concerned Lab. Teacher and another faculty member of the same Department as assigned by the Head of the Department.

9.4 There shall be a Seminar Presentation in II Year I(III) Semester or II(IV) Semester. For the Seminar, the Student shall collect the information on a specialized topic, prepare a Technical Report and submit to the Department at the time of Seminar Presentation. The Seminar Presentation (along with the Technical Report) shall be evaluated by Two Faculty Members assigned by Head of the Department, for 100 Marks. There shall be no SEE or External Examination for Seminar.

9.5 Each Student shall appear for a Comprehensive Viva-Voce at the end of the V Semester (III Year I Semester). The Comprehensive Viva-Voce shall be conducted by a Committee, consisting of three senior faculty members of Department nominated by the Head of the Department, and the performance evaluation shall be for 100 Marks. There are no Internal Marks for the Comprehensive Viva-Voce.

9.6 a) Every PTPGP Student shall be required to execute his M.Tech. Project, under the guidance of the Supervisor assigned to him by the Head of Department. The PTPGP Project shall start immediately after the completion of the II Year II(IV) Semester, and shall continue through III Year I (V) and II (IV) Semesters. The Student shall carry out the literature survey, select an appropriate topic and submit a Project Proposal within 6 weeks (immediately after his II Year II Semester (IV) End Examinations), for approval by the Project Review Committee (PRC). The PRC shall be constituted by the Head of Department, and shall consist of the Head of Department, Project Supervisor, and a Senior Faculty Member of the Department. The Student shall present his Project Work Proposal to the PRC (PRC-I Presentation), on whose approval he can 'REGISTER for the PG Project'. Every Student must compulsorily register for his M.Tech. Project Work, within the 6 weeks of time-frame as specified above. After Registration, the Student shall carry out his work, and continually submit 'a fortnightly progress report' to his Supervisor throughout the Project period. The PRC will monitor the progress of the Project Work and review, through PRC-II and PRC-III Presentations – one at the end of the III Year I (V) Semester, and one before the submission of M.Tech. Project Work Report/ Dissertation.

b) After PRC-III presentation, the PRC shall evaluate the entire performance of the Student and declare the Project Report as 'Satisfactory' or 'Unsatisfactory'. Every Project Work Report/ Dissertation (that has been

declared 'satisfactory') shall undergo 'Plagiarism Check' as per the University/ College norms to ensure content plagiarism below a specified level of 30%, and to become acceptable for submission. In case of unacceptable plagiarism levels, the student shall resubmit the Project Work Report, after carrying out the necessary modifications/ additions to his Project Work/ Report as per his Supervisor's advice, within the specified time, as suggested by the PRC.

c) If any Student could not be present for PRC-II at the scheduled time (after approval and registration of his Project Work at PRC-I), his submission and presentation at the PRC-III time (or at any other PRC specified dates) may be treated as PRC-II performance evaluation, and delayed PRC-III dates for him may be considered as per PRC recommendations. Any Student is allowed to submit his M.Tech. Project Dissertation 'only after completion of 40 weeks from the date of approval/registration' of his Project, and after obtaining all approvals from the PRC.

d) A total of 200 Marks are allotted for the M.Tech. Project Work, (out of which 100 Marks are allotted for internal evaluation and 100 Marks for external evaluation). For internal Evaluation of 100 marks, Project Supervisor shall evaluate for 60 marks based on the continuous Internal Evaluation(CIE) of the student's performance and combined PRC-I, II & III performance evaluation will be for 40 marks (to be awarded by PRC, as SEE).

9.7 a) The Student shall be allowed to submit his Project Dissertation, only on the successful completion of all the prescribed PG Subjects (Theory and Labs.), Seminar, Comprehensive Viva-voce etc. (securing B Grade or above), and after obtaining all approvals from PRC. In such cases, the M.Tech. Dissertations will be sent to an External Examiner nominated by the Principal of the College, on whose 'approval', the Student can appear for the M.Tech. Project Viva-voce Examination, which shall be conducted by a Board, consisting of the PG Project Supervisor, Head of the Department, and the External Examiner who adjudicated the M.Tech. Project Work and Dissertation. The Board shall jointly declare the Project Work Performance as 'satisfactory', or 'unsatisfactory'; and in successful cases, the External Examiner shall evaluate the Student's Project Work presentation and performance for 100 Marks (SEE).

b) If the adjudication report of the External Examiner is 'not favourable' , then the Student shall revise and resubmit his Dissertation after one Semester, or as per the time specified by the External Examiner and/ or the PRC. If the resubmitted report is again evaluated by the External Examiner as 'not favourable', then that Dissertation will be summarily rejected. Subsequent actions for such Dissertations may be considered, only on the specific recommendations of the External Examiner and/ or PRC.

c) In cases, where the Board declared the Project Work Performance as 'unsatisfactory', the Student is deemed to have failed in the Project Viva-voce Examination, and he has to reappear for the Viva-voce Examination as per the Board recommendations. If he fails in the second Viva-voce Examination also, he will not be considered eligible for the Award of the Degree, unless he is asked to revise and resubmit his Project Work by the Board within a specified time period (within 6 years from the date of commencement of his I Year I Semester).

10.0 Re-Admission / Re-Registration:

10.1 **Re-Admission for Discontinued Students:**
Students, who have discontinued the M.Tech. Degree Programme due to any reasons what so ever, may be considered for 'Readmission' into the same Degree Programme (with same specialization) with the Academic Regulations of the Batch into which he gets readmitted, with prior permission from the concerned authorities, subject to Item 4.1.

10.2 Re-Registration for Detained Students:
When any Student is detained in a Subject (s)/ Seminar due to shortage of attendance in any Semester, he may be permitted to re-register for the same Subject in the 'same category' (Core or Elective Group) or equivalent Subject if the same Subject is not available, as suggested by the Board of Studies of that Department, as when offered in the sub-sequent Semester(s), with the Academic Regulations of the Batch into which he seeks re-registration , with prior permission from the concerned authorities, subject to Item 4.1.

11.0 Grading Procedure:

11.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

11.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
80% and above (≥ 80% , ≤ 100%)	O (Outstanding)	10
Below 80% but not less than 70% (≥ 70% , < 80%)	A^+ (Excellent)	9
Below 70% but not less than 60% (≥ 60% , < 70%)	A (Very Good)	8
Below 60% but not less than 55% (≥ 55% , < 60%)	B^+ (Good)	7
Below 55% but not less than 50% (≥ 50% , < 55%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

11.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

11.4 A Letter Grade does not imply any specific % of Marks.

11.5 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

11.6 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = { $\sum_{i=1}^{N} C_i \, G_i$ } / { $\sum_{i=1}^{N} C_i$ } …. For each Semester,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the i^{th} Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

11.7 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year second Semester onwards, at the end of each Semester, as per the formula

CGPA = { $\sum_{j=1}^{M} C_j \, G_j$ } / { $\sum_{j=1}^{M} C_j$ } … for all S Semesters registered
(ie., upto and inclusive of S Semesters, S ≥ 1),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the j^{th} Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that j^{th} Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

11.8 For Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs will be used.

11.9 For Calculations listed in Item 11.5 – 11.8, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

11.10 A student shall be declared successful or 'passed' in a Semester, only when he gets a SGPA ≥ 6.00 (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire PGP, only when gets a CGPA ≥ 6.00; subject to the condition that he secures a GP ≥ 6 (B Grade or above) in every registered Subject/ Course in each Semester (during the entire PGP) for the Degree Award, as required.

11.11 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned etc.), Credits earned, SGPA, and CGPA.

11.12 Passing Standards :

11.12.1 A Student shall be declared successful or 'passed' in a Semester, only when he gets a SGPA $\geq$ 6.00 (at the end of that particular Semester); and a Student shall be declared successful or 'passed' in the entire PGP, only when gets a CGPA $\geq$ 6.00; subject to the condition that he secures a GP $\geq$ 6 (B Grade or above) in every registered Subject/ Course in each Semester (during the entire PGP), for the Award of the Degree, as required.

11.12.2 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned), Credits earned, SGPA, and CGPA etc.

12.0 Declaration of Results:

12.1 Computation of SGPA and CGPA are done using the procedure listed in 11.5 – 11.8.

12.2 For Final % of Marks equivalent to the computed CGPA, the following formula may be used ..

% of Marks = (CGPA – 0.5) x 10

13.0 Award of Degree and Class:

13.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PTPG Programme (PTPGP), and secures the required number of **90** Credits (with GP $\geq$ 6.0), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

13.2 **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following four classes based on the % CGPA:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75 ≤ CGPA < 7.75
Second Class	6.00 ≤ CGPA < 6.75

13.3 A student with final CGPA (at the end of the PTPGP) < 6.00 will not be eligible for the Award of Degree.

14.0 Withholding of Results:

14.1 If a Student has not paid fees to University/ College at any stage, or has pending dues against his name due to any reason whatsoever, or if any case of indiscipline is pending against him, the result of the Student may be withheld, and he will not be allowed to go into the next higher Semester. The Award or issue of the Degree may also be withheld in such cases.

15.0 Transitory Regulations:

15.1 A Student - who has discontinued for any reason, or who has been detained for want of attendance as specified, or who has failed after having undergone PTPGP, may be considered eligible for readmission to the same PTPGP with same set of Subjects/ Courses (or equivalent Subjects/ Courses as the case may be), and same Professional Electives (or from same set/category of Electives or equivalents as suggested), as and when they are offered (within the time-frame of 6 years from the Date of Commencement of his I Year I Semester).

16.0 Student Transfers:

16.1 There shall be no Branch/ Specialization transfers after the completion of Admission Process.

16.2 There shall be no transfer among the Constituent Colleges and Units of Jawaharlal Nehru Technological University Hyderabad.

17.0 Scope:

i) Where the words “he”, “him”, “his”, occur in the write-up of regulations, they include “she”, “her”, “hers”.
ii) Where the words “Subject” or “Subjects”, occur in these regulations, they also imply “Course” or “Courses”.
iii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.
iv) In case of any doubt or ambiguity in the interpretation of the above regulations, the decision of the Vice-Chancellor/ Principal is final.
v) The College may change or amend the Academic Regulations, and/ or Course Structure, and/ or Syllabi at any time, and the changes or amendments made shall be applicable to all Students with effect from the dates as notified by the University/ College.

18. MALPRACTICES RULES:

	Nature of Malpractices	Punishment
	If the candidate:	
1 (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1 (b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the Chief Superintendent / Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining

		examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a 8police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the College / University for further action to award suitable punishment.	

19. GENERAL:

- **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- **Credit Point:** It is the product of grade point and number of credits for a course.
- The Academic Regulations should be read as a whole for the purpose of any interpretation.
- The University/College reserves the right of altering the Academic Regulations and/or Syllabus/Course Structure, as and when necessary. The modifications or amendments may be applicable to all the candidates on rolls, as specified by the University/College.
- Wherever the words 'he' or 'him' or 'his' occur in the above regulations, they will also include 'she' or 'her' or 'hers'.
- Wherever the word 'Subject' occurs in the above regulations, it implies the 'Theory Subject', 'Practical Subject' or 'Lab.' and 'Seminar'.
- In case of any ambiguity or doubt in the interpretations of the above regulations, the decision of the Vice-Chancellor will be final.

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JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (Structural Engineering) – PTPG w.e.f. 2016-2017

I SEMESTER

S.No.	Subject	L	T	P	Credits
1	Theory of Elasticity	4	0	0	4
2	Elective – I	4	0	0	4
3	Elective – II	4	0	0	4
4	Advanced Concrete Laboratory	0	0	4	2
	TOTAL CREDITS				**14**

II SEMESTER

S.No.	Subject	L	T	P	Credits
1	Advanced Reinforced Concrete Design	4	0	0	4
2	Elective- III	4	0	0	4
3	Elective- IV	4	0	0	4
4	Soft Skills Lab	0	0	4	2
	TOTAL CREDITS				**14**

III SEMESTER

S.No.	Subject	L	T	P	Credits
1	Structural Dynamics	4	0	0	4
2	Elective- V	4	0	0	4
3	Elective -VI	4	0	0	4
4	CAD Laboratory	0	0	4	2
	TOTAL CREDITS				**14**

IV SEMESTER

S.No.	Subject	L	T	P	Credits
1	Finite Element Methods	4	0	0	4
2	Elective - VII	4	0	0	4
3	Elective - VIII	4	0	0	4
4	Seminar	0	0	4	2
	TOTAL CREDITS				**14**

V SEMESTER

S.No.	Subject	L	T	P	Credits
1	Comprehensive Viva Voce	-	-	-	4
2	Project Phase- I	-	-	-	12
	TOTAL CREDITS				**16**

VI SEMESTER

S.No.	Subject	L	T	P	Credits
1	Project Phase - II & Dissertation	-	-	-	18
	TOTAL CREDITS				**18**

ELECTIVES I & II

1. Computer Oriented Numerical Methods
2. Advanced Concrete Technology
3. Experimental Stress Analysis
4. Advanced Foundation Engineering

ELECTIVES III & IV

1. Advanced Structural Analysis
2. Soil Dynamics and Machine Foundations
3. Fracture Mechanics of Concrete Structures
4. Analysis of Plates & Shells
5. Optimization Techniques in Structural Engineering

ELECTIVE V& VI

1. Advanced Steel Design
2. Design of Pre stressed Concrete Structures
3. Stability of Structures
4. Composite Materials
5. Rehabilitation and Retrofitting of Structures

ELECTIVE VII& VIII

1. Earthquake Resistant Design of Buildings
2. Principles of Bridge Engineering
3. Plastic Analysis and Design
4. Design of Industrial Structures

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

THEORY OF ELASTICITY

Objectives:
To impart knowledge on the basic concepts of theory of elasticity, and solve the Structural Engineering problems.

Course outcomes:
The learner will be able to solve problems of elasticity and plasticity and be able to apply numerical methods to solve continuum problems.

Prerequisites: Strength of Materials I & II

UNIT-I
Introduction: Elasticity - notation for forces and stress - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - differential equations of equilibrium - boundary conditions – Strain Displacement Relations - compatibility equations - stress function

UNIT II
Two dimensional problems in rectangular coordinates - solution by polynomials - Saint-Venants principle - determination of displacements - bending of simple beams – Simple Supported and Cantilever Beam.

UNIT III
Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions Edge Dislocation - general solution of two-dimensional problem in polar coordinates - application to Plates with Circular Holes – Rotating Disk. Bending of Prismatic Bars: Stress function - bending of cantilever - circular cross section - elliptical cross section - rectangular cross section.

UNIT IV
Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses Stress Invariants - max shear stresses Stress Tensor – Strain Tensor- Homogeneous deformation - principal axes of strain-rotation. General Theorems: Differential equations of equilibrium - conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem Strain Energy.

UNIT V
Torsion of Circular Shafts - Torsion of Straight Prismatic Bars – Saint Venants Method - torsion of prismatic bars - bars with elliptical cross sections - membrane analogy - torsion of a bar of narrow rectangular bars - solution of torsional problems by energy method - torsion of shafts, tubes , bars etc.Torsion of Rolled Profile Sections.

References
1. Theory of Elasticity by Timeshenko, McGrawhill Publications.
2. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
3. Theory of Elasticity by Y.C.Fung.
4. Theory of Elasticity by Gurucharan Singh.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

COMPUTER ORIENTED NUMERICAL METHODS
(Elective – I & II)

Objectives:
To impart knowledge about various methods of analysing linear equations and understand the different mathematical techniques.

Outcome:
The learner will be able to apply various mathematical techniques to Structural engineering problems.

Prerequisites : Mathematics I & II

UNIT I:
Solutions of linear equations: Direct method – Cramer's rule, Guass – Elimination method- Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over –relaxation method. Eigen values and eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

UNIT II:
Interpolation: Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

UNIT III
Finite Difference and their Applications: Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulas using Taylor series- Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas- Numerical solution to spatial differential equations – Application to Simply Supported Beams, Columns & rectangular Plates.

UNIT IV.
Numerical Differentiation: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation.
Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method – New Marks Method and Application to Beams – Calculations of Slopes & Deflections.

UNIT V
Ordinary Differential Equation: Euler's method – Backward Euler method – Mid point method – single step method, Taylor's series method- Boundary value problems.

References:

1. Numerical Methods For Scientific and Engineering Computations. M.K.Jain-S.R.K.Iyengar – R.K.Jain Willey Eastern Limited. New Age International (p) Ltd., Publishers, Reprint 2004,ISBN:81-224-1461-3 56789101112.
2. Numerical Methods for Engineering Problems by N. Krishna Raju and K.U. Muthu, M.C. Millan Publishers, New Delhi
3. Numerical Methods for Engineers Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill Book Company. April 2009
4. C Language and Numerical methods by C.Xavier – New Age International Publisher. Reprint March 2012 ISBN:978-81-224-1174-4.
5. Computer based numerical analysis by Dr. M.Shanta Kumar, Khanna Book publishers New Delhi.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED CONCRETE TECHNOLOGY
(Elective – I & II)

Objectives:
To impart knowledge on concrete making materials, concrete mix design for proportioning and their testing.

Outcomes:
The learner will be able to design concrete mixes of different grades and also use the special concretes.

Prerequisites : Concrete Technology

UNIT – I
Concrete Making Materials : Cement – Bogus Compounds – Hydration Process – Types of Cement – Aggregates – Gradation Charts – Combined Aggregate – Alakali Silica Reaction – Admixtures – Chemical and Mineral Admixtures. Bureau of Indian Standards (BIS) Provisions.

UNIT – II
Fresh And Hardened Concrete: Fresh Concrete – workability tests on Concrete – Setting Times of Fresh Concrete – Segregation and bleeding.
Hardened Concrete : Abrams Law, Gel space ratios, Maturity concept – Stress strain Behaviour – Creep and Shrinkage – Durability Tests on Concrete – Non Destructive Testing of Concrete. BIS Provisions.

UNIT – III
High Strength Concrete – Microstructure – Manufacturing and Properties – Design of HSC Using Erintroy Shaklok method – Ultra High Strength Concrete.
High Performance Concrete – Requirements and Properties of High Performance Concrete – Design Considerations. BIS Provisions.

UNIT – IV
Special Concretes : Self Compacting concrete, Polymer Concrete, Fibre Reinforced Concrete – Reactive Powder Concrete – Requirements and Guidelines – Advantages and Applications.
Concrete Mix Design: Quality Control – Quality Assurance – Quality Audit - Mix Design Method – BIS Method – DOE Method – Light Weight Concrete, Self Compacting Concrete.

UNIT – V
Form work – materials – structural requests – form work systems – connections – specifications – design of form work – shores – removal for forms - shores – reshoring – failure of form work.

REFERENCES:
1. Properties of Concrete by A.M.Neville, ELBS publications Oct 1996.
2. Concrete: Micro Structure, Properties and Materials by P.K.Mehta and P.J.Monteiro,. Mc. Graw-Hill Publishing Company Ltd. New Delhi
3. Concrete Technology by M.S.Shetty, S.Chand & Co 2009.
4. Concrete Technology by A.R. Santhakumar, Oxford University Press Oct 2006.
5. Design of Concrete Mixes by N.Krishna Raju, CBS Publications, 2000.
6. Special Structural concretes by Rafat Siddique, Galgotia Publications 2000.
7. Relevant BIS Codes

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

EXPERIMENTAL STRESS ANALYSIS
(Elective – I & II)

Objectives:
To impart knowledge on the strain measurement, brittle coating and photo elasticity.

Outcomes : The learner will be able to understand the properties of strain-gauge systems and the computation techniques.

Prerequisites : Strength of Materials I & II

UNIT I
Basic equations and Plane Elasticity Theory: Introduction, Strain equations of Transformation, Compatibility, Stress-Strain Relations-Two dimensional State of Stress. The Plane-Elastic problem. Two dimensional problems in Polar Co-ordinates, Polar Components of Stress in terms of Airy's Stress function, Forms. Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis-Advantages of experimental stress analysis, Different methods, Simplification of problems.

UNIT II
Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges- Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc.

Strain Rosettes: Introduction, The three element rectangular Rosette - The delta rosette - Corrections for Transverse strain effects.

UNIT III
Brittle Coating Method: Introduction, Coating stresses - Failure theories - Brittle coating Crack pattern - Crack detection - Types of Brittle coating - Test procedures for brittle coating analysis - Calibration procedures - Analysis of brittle coating data.

UNIT IV
Theory of Photo Elasticity: Introduction, Temporary double refraction - The stress optic law - Effects of stressed model in a Polaris cope for various arrangements - Fringe sharpening, Brewster stress optic law.

UNIT V
Two Dimensional Photo Elasticity: Introduction, Isochromatic Fringe patterns - Isoclinic fringe patterns, passage of light through plane Polaris cope and circular Polaris cope, Isoclinic fringe pattern - Compensation techniques - calibration methods, separation methods, scaling Model to Proto type stress- Materials for photo - elasticity, properties of photo elastic materials.

REFERENCES:
1. Experimental Stress Analysis by J.W.Dally and W.F.Riley, 2007
2. Experimental Stress Analysis by Dr. Sadhu Singh, Khanna Publishers, New Delhi
3. Experimental Stress Analysis by Dove and Adams 2006, Macmillan Publishing Company

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED FOUNDATION ENGINEERING
(Elective – I & II)

Prerequisites: Foundation Engineering or Geotechnical Engineering-II

OBJECTIVE:
To determine the bearing capacity of shallow and deep foundations, to estimate settlements of structures subjected to external loads, leading to design of foundations resting on soils.

OUTCOME:
Students should be in a position to design foundations for varieties of structures resting on soil deposits, and appreciate the importance of reliability based design in geotechnical engineering.

UNIT- I
Soil Exploration: Exploration Methods; Planning the Exploration Program; Boring and Sampling; In Situ Tests: Standard & Cone Penetration Tests, Field Vane & Borehole shear tests, Dilatometer, Pressuremeter; Rock Sampling, Core Recovery, RQD; Geophysical Exploration; Preparation of Soil Report.

UNIT- II
Shallow Foundations: **Bearing Capacity:**- General Formulae; Effect of Water Table; Footings with eccentric or Inclined Loads, Foundations on Layered Soils, on finite layer with a Rigid Base at Shallow Depth, effect of compressibility of soil.

UNIT- III
Settlement: Components – Immediate, Consolidation & Creep, Stresses and Displacements in Homogeneous, Layered and Anisotropic Soils; Consolidation Settlement; One, Two & Three Dimensional Consolidation; Secondary Compression Settlement; Bearing Pressure using SPT, CPT, Dilatometer and Pressuremeter; Settlement of foundations on Sands-Schmertmann and Burland & Busbridge methods; Structure Tolerance to Settlement and Differential Settlements, Rotation of Tall Structures.

UNIT- IV
Deep Foundations: **Single Pile:** Vertically loaded piles, Static capacity α, β and λ Methods, Dynamic formulae; Point Bearing Resistance with SPT and CPT Results; Bearing Resistance of Piles on Rock; Settlement; Pile Load Test; Uplift Resistance; Laterally Loaded Piles -Ultimate Lateral Resistance; Negative Skin Friction; Batter Piles; Under Reamed Piles; Ultimate Capacity of Pile Groups in Compression, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups; Interaction of Axially & Laterally Loaded Pile Groups.

UNIT- V
Special Topics of Foundation Engineering
Foundations on Collapsible Soils: Origin and occurrence, Identification, Sampling and Testing, Preventive and Remedial measures.
Foundations on Expansive Soils: The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and Preventive design & construction measures.
Introduction to Reliability-Based Design: Methods, LRFD for structural strength requirements, LRFD for geotechnical strength requirements, Serviceability requirements.

REFERENCE:

1. Das, B. M. - Principles of Foundation Engineering 5th Edition Nelson Engineering (2004)
2. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012. Phi Learning (2008)
3. Bowles, J. E. - Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc. (1996)
4. Poulos, H. G. & Davis, E. H. - Pile Foundation Analysis and Design john wiley & sons inc (1980-08)
5. Reese, L. C. & Van Impe, W. F. - Single Piles and Pile Groups under Lateral Loading - Taylor & Francis Group (Jan 2000)
6. Tomlinson, M. J. - Foundation Design and Construction - Prentice Hall (2003)
7. Lymon C. Reese, William M. Isenhower, Shin-Tower Wang- Analysis and Design of Shallow and Deep Foundations (2006)
8. Salgado, R. - The Engineering of Foundations McGraw-Hill, Boston (2008)

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) I-Sem (Structural Engineering)

L	T	P	C
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ADVANCED CONCRETE LABORATORY

Objectives: To impart knowledge on the test on cement and aggregates.

Outcomes:
The learner will be able to understand the properties of the materials and the behavior of the concrete.

Prerequisites : Concrete Technology Lab

1. Gradation Charts of Aggregates.
2. Bulking of fine Aggregate.
3. Aggregate Crushing and Impact value
4. Workability Tests on Fresh Self Compacting Concrete
6. Air Entrainment Test on Fresh Concrete
7. Rapidly Chloride Permeability Test.
8. Non Destructive Testing of Concrete.
9. Accelerated Curing of Concrete (Demo).
10. Behavior of Under Reinforced, over Reinforced and Shear Behavior of Beams.
11. Influence of W/C Ratio on Strength and Aggregate / Cement Ratio on Strength & Workability.
12. Influence of Different Chemical Admixtures on Concrete
13. Marsh Cone Test.

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M.Tech. (PTPG) II-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED REINFORCED CONCRETE DESIGN

Objectives:
To impart knowledge on the behavior and design on various reinforced concrete structural elements.

Outcome:
The learner will be able to design the reinforced concrete elements like beams, slabs and compression members.

Prerequisites : Design of Reinforced Concrete Structures

UNIT I
Basic Design Concepts: Behavior in flexure, Design of singly Reinforced rectangular sections, Design of Doubly Reinforced rectangular sections, Design of flanged bean sections, Design for shear – Design for Torsion**,** Limit state of Serviceability**:** Deflections of Reinforced concrete beams and slabs short term deflections and long term deflection estimation of crack width in RCC members, calculation of crack widths.

UNIT II
Limit Analysis of R.C.Structures: Rotation of a plastic hinge, Redistribution of moments, moment rotation characteristics of RC member, I.S. code provisions, applications for fixed and continuous beam. Yield line analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis – For square and circular slabs with simple and continuous end conditions. Moment Curvature diagram.

UNIT III
Design of Ribbed slabs, Flat slabs: Analysis of the Slabs for Moment and Shears, Ultimate Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements.
Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears-Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip.

UNIT IV
Design of Reinforced Concrete Deep Beams & Corbels: Steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams, Analysis of Forces in a Corbels , Design of Procedure of Corbels , Design of Nibs.

UNIT V
Design of Compression Members - Estimation of Effective Length of a Column – Code Requirements on Slenderness Limits,– Design of Short Columns Under Axial Compression – Design of Short Columns Under Compression With Uniaxial Bending – Design of Short Columns Under Axial Compression With Biaxial Bending – Design of Slender Columns.

Design of Combined Footings - Distribution of Soil Pressure - Geometry of Two-column Combined Footing – Design Considerations in Two-Column Footings.

REFERENCE:

1. "Reinforced Concrete Design" S. Unnikrishna Pillai & Devdas Menon; Tata Mc. Graw-Hill Publishing Company Ltd. New Delhi 2010.
2. "Advanced Reinforced Concrete" P.C. Varghese Prentice Hall of INDIA Private Ltd. 2008.
3. "Limit State Theory and Design of Reinforced Concrete" Dr. S. R. Karve and V.L Shah. Standard Publishers, PUNE 2004.
4. "Design of Reinforced Concrete Structures" by N.Subramanian, Oxford University Press.
5. Reinforced concrete structural elements – behaviour, Analysis and design by P. Purushotham, Tata Mc.Graw-Hill, 1994.
6. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
7. Reinforced Concrete design by Kennath Leet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
8. "Design Reinforced Concrete Foundations" P.C. Varghese Prentice Hall of INDIA Private Ltd.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) II-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED STRUCTURAL ANALYSIS
(Elective – III & IV)

Objectives:
To impart knowledge on the analysis of indeterminate structures like continuous beams, trusses and portal frames.

Outcome:
The learner will be able to analyse different indeterminate structures using Matrix methods.

Prerequisites : Structural Analysis I & II

UNIT I
Introduction to matrix methods of analysis - statical indeterminacy and kinematical indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and torsional element.
Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

UNIT II
Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - banded matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

UNIT III
Analysis of plane truss - continuous beams with and without settlement - plane frame including side sway grids, by flexibility methods and gables frames by System Approach.

UNIT IV
Analysis of plane truss - continuous beams with and without settlement - plane frame including sides sway, grids and gable frames by stiffness methods.

UNIT V. Special analysis procedures - static condensation and sub structuring - initial and thermal stresses.
Shear walls- Necessity - structural behaviour of large frames with and without shear walls - approximate methods of analysis of shear walls.

REFERENCES
1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Gere, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
3. Basic Structural Analysis by C.S.Reddy.
4. Matrix Structural Analysis by Madhu B. Kanchi.
5. Indeterminate Structural Analysis by K.U.Muthu *et al*.,I.K.International Publishng House Pvt. Ltd.
6. Matrix Methods of Structural Analysis by J.Meek.
7. Structural Analysis by Ghali and Neyveli.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. (PTPG) II-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

SOIL DYNAMICS AND MACHINE FOUNDATIONS
(Elective – III & IV)

OBJECTIVE:
To understand the wave propagation in soils, determine dynamic properties of soil for analyzing and designing foundations subjected to vibratory loading.

OUTCOME:
Able to understand the fundamentals of wave propagation in soil media, evaluate the dynamic properties of soil, and design foundations for centrifugal and reciprocating machines.

Prerequisites : Soil Machines, Foundation Engineering and Structural Analysis

UNIT I : Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.

UNIT II : Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress-strain behaviour of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties - Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays.

UNIT III : Foundation Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Vertical vibration of circular foundations resting on Elastic Half Space- Lambs, Reissner, Quinlan & Sungs Hsiehs and Lysmers analogies.

UNIT IV: Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.

UNIT V : Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

Text Books:

1. Swami Saran - Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd. (2010)
2. Prakash, S. - Soil Dynamics, McGraw Hill Book Company (1981)

References:

1. I.Cshowdhary and S P Dasgupta - Dynamics of Structures and Foundation, 2009.
2. Arya, S. D, O'Neil, M. and Pincus, G.- Design of Structures and Foundations for Vibrating Machines, Gulf Publishing Co., 1979.
3. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
4. Kameswara Rao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F. E. Hall J. R and Woods R. D. - Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
6. Das, B. M. - Principles of Soil Dynamics, PWS KENT publishing Company, Boston.2002.
7. Bharat Bhushan Prasad – Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Limited, New Delhi, 2011.

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FRACTURE MECHANICS OF CONCRETE STRUCTURES
(Elective – III & IV)

Objectives:
To impart knowledge on the mechanisms of failure and non linear fracture mechanics.

Outcomes:
The learner will be able to understand the behavior of concrete with tension and compression failure surfaces and concepts of CTOD and CMD.

Prerequisites : Concrete Technology Strength of Materials I & II

UNIT I
Fundamentals of Fracture Mechanics, Mechanisms of fracture and crack growth

UNIT II
Cleavage fracture, ductile fracture, fatigue cracking, Environment assisted cracking, Quasi brittle materials.

UNIT III
Service failure analysis, linear elastic fracture mechanics, Griffith's criteria, stress intensity factors, crack tip plastic zone, Erwin's plastic zone correction, R curves, compliance, J Integral, nonlinear analysis ,Review of concrete behaviour in tension and compression, Basic frameworks for modeling of quasibrittle materials.

UNIT IV
Nonlinear Fracture Mechanics – Discrete crack concept/Smeared crack concept, Size effect, Plasticity models for concrete – Associated and non-associated flow, Failure surfaces for quasibrittle materials.

UNIT V
Concept of CTOD and CMD, Material models, crack models, band models, models based on continuum damage mechanics

REFERENCES:
1. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Alphen aan den Rijn – Netherlands
2. Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by L. Elfgreen – Chapman and Hall – 1989.
3. Fracture mechanics – applications to concrete – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118.
4. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi.
5. Venkataraman and Patel "Structural Mechanics with introduction to Elasticity and Plasticity" – Mcgraw Hill, 1990.
6. Shanes – "Introduction to Solid Mechanics – II Edition, PH, 1989.

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ANALYSIS OF PLATES & SHELLS
(Elective – III & IV)

Objectives:
To impart knowledge on the behavior and design of shells and Folded plates.

Outcomes:
The learner will be able to analyse and design the shells and folded plates.

Prerequisites : Theory of Elasticity, Structural Analysis

UNIT I
Small Deflection Theory of Thin Rectangular Plates : Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure.

UNIT II
Plates on Elastic Foundations : Governing differential equation – deflection of uniformly loaded simply supported rectangular plate – Navier and Levy type solutions - Large plate loaded at equidistant points by concentrated forces.

UNIT III
Buckling of Plates: Governing equation for Bending of plate under the combined action of in-plane loading and lateral loads – Buckling of rectangular plates by compressive forces acting in one and two directions in the middle plane of plate

UNIT IV
Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation.
Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT V
Introduction to the shells of Double curvatures:_ Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type.

Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers.

REFERENCES:
1 Design of concrete shell roofs By Billington – Tata MC Graw Hill, New York
2 Shell Analysis By N.K.Bairagi. Khanna Publishers, New Delhi.
3. Theory of Plates and Shells by Timoshenko- Tata MC Graw Hill, College
4. Analysis and design of concrete shell roofs By G.S.Ramaswami. CBS publications.
5. Design of concrete shell roofs By Chaterjee. Oxford and IBH.

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OPTIMIZATION TECHNIQUES IN STRUCTURAL ENGINEERING
(Elective – III & IV)

OBJECTIVE:
To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.

OUTCOME:
The student will be able to understand the basic principles of optimization, and in a position to formulate optimization models for a wide range of civil engineering problems and able to solve them.

Prerequisites : Mathematics I&II

UNIT I : Introduction to Optimization: Introduction - Historical developments - Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization problems - Optimization Techniques. Optimization by calculus: Introduction - Unconstrained functions of a single variable - Problems involving simple constraints - Unconstrained functions of several variables - treatment of equality constraints - Extension to multiple equality constraints - Optimization with inequality constraints - The generalized Newton-Raphson method.

UNIT II : Linear Programming: Introduction - Applications of linear programming - standard form of a linear programming problem - Geometry of linear programming problems - Definitions and theorems - Solution of a system of Linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the Simplex Method - Simplex Algorithm - Two phases of the simplex method. non-Linear Programming: Introduction - Unimodal Function - Unrestricted search - Exhaustive search - Dichotomous search - Interval Halving method - Fibonacci method - Golden section method - Comparison of elimination methods - Unconstrained optimization techniques - Direct search methods - Random search methods - grid search method - Univariate method - Powell's method - Simplex method - Indirect search methods - Gradient of a function - Steepest descent method - Conjugate gradient - Newton's method.

UNIT III : Dynamic Programming: Introduction - Multistage decision processes - concept of sub-optimization and the principle of optimality - computational procedure in dynamic programming - example illustrating the Calculus method of solution - example illustrating the Tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic programming - Additional applications.

UNIT IV : Network Analysis: Introduction - Elementary graph theory - Network variables and problem types - Minimum-cost route - Network capacity problems - Modification of the directional sense of the network.

UNIT V: Application of Optimization techniques to trusses, Beams and Frames.

REFERENCES

1. Optimization: Theory and Applications by S.S.Rao. New Age International (p) Ltd.
2. Numerical Optimization Techniques for Engineering Design with applications by G.N.Vanderplaats 2007.
3. Elements of Structural Optimization by R.T.Haftka and Z.Gurdal Kluwer academic publishers
4. Optimum Structural Design by U.Kirsch. Tata Mc Graw Hill
5. Optimum Design of Structures by K.I.Majid.
6. Introduction to Optimum Design by J.S.Arora. Academic press, 2012 ISBN : 978-0-12-381375-6.

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SOFT SKILLS LAB
(Activity-based)

Course Objectives

- To improve the fluency of students in English
- To facilitate learning through interaction
- To illustrate the role of skills in real-life situations with case studies, role plays etc.
- To train students in group dynamics, body language and various other activities which boost their confidence levels and help in their overall personality development
- To encourage students develop behavioral skills and personal management skills
- To impart training for empowerment, thereby preparing students to become successful professionals

Learning Outcomes

- Developed critical acumen and creative ability besides making them industry- ready.
- Appropriate use of English language while clearly articulating ideas.
- Developing insights into Language and enrich the professional competence of the students.
- Enable students to meet challenges in job and career advancement.

INTRODUCTION

Definition and Introduction to Soft Skills – Hard Skills vs Soft Skills – Significance of Soft/Life/Self Skills – Self and SWOT Analysis ***and***

1. **Exercises on Productivity Development**
   - Effective/ Assertive Communication Skills (Activity based)
   - Time Management (Case Study)
   - Creativity & Critical Thinking (Case Study)
   - Decision Making and Problem Solving (Case Study)
   - Stress Management (Case Study)
2. **Exercises on Personality Development Skills**
   - Self-esteem (Case Study)
   - Positive Thinking (Case Study)
   - Emotional Intelligence (Case Study)
   - Team building and Leadership Skills (Case Study)
   - Conflict Management (Case Study)
3. **Exercises on Presentation Skills**
   - Netiquette
   - Importance of Oral Presentation – Defining Purpose- Analyzing the audience- Planning Outline and Preparing the Presentation- Individual & Group Presentation- Graphical Organizers- Tools and Multi-media Visuals
   - One Minute Presentations (Warming up)
   - PPT on Project Work- Understanding the Nuances of Delivery- Body Language – Closing and Handling Questions – Rubrics for Individual Evaluation (Practice Sessions)
4. **Exercises on Professional Etiquette and Communication**
   - Role-Play and Simulation- Introducing oneself and others, Greetings, Apologies, Requests, Agreement & Disagreement….etc.

- Telephone Etiquette
- Active Listening
- Group Discussions (Case study)- Group Discussion as a part of Selection Procedure- Checklist of GDs
- Analysis of Selected Interviews (Objectives of Interview)
- Mock-Interviews (Practice Sessions)
- Job Application and Preparing Resume
- Process Writing (Technical Vocabulary) – Writing a Project Report- Assignments

5. Exercises on Ethics and Values

Introduction –– Types of Values - Personal, Social and Cultural Values - Importance of Values in Various Contexts

- Significance of Modern and Professional Etiquette – Etiquette (Formal and Informal Situations with Examples)
- Attitude, Good Manners and Work Culture (Live Examples)
- Social Skills - Dealing with the Challenged (Live Examples)
- Professional Responsibility – Adaptability (Live Examples)
- Corporate Expectations

☞ Note: Hand-outs are to be prepared and given to students.

☞ Training plan will be integrated in the syllabus.

☞ Topics mentioned in the syllabus are activity-based.

SUGGESTED SOFTWARE:

☞ The following software from **'train2success.com'**

- Preparing for being Interviewed
- Positive Thinking
- Interviewing Skills
- Telephone Skills
- Time Management
- Team Building
- Decision making

SUGGESTED READING:

1. Alex, K. 2012. *Soft Skills.* S. Chand Publishers
2. *Management Shapers*. 2011. Collection of 28 Books by different Authors. Universities Press.
3. Sherfield, Robert M. *2005. et al Cornerstone: Developing Soft Skills*. Pearson
4. Suresh Kumar,E; Sreehari, P. & Savithri, J. 2011. *Communication Skills and Soft Skills- An Integrated Approach.* New Delhi: Pearson
5. The ACE of Soft Skills by Gopalaswamy Ramesh & Mahadevan Ramesh. 2013. Pearson Publishers. New Delhi.
6. Patnaik, P. 2011. *Group Discussion and Interview Skills.* New Delhi: Foundation
7. Sudhir Andrews. 2009. *How to Succeed at Interviews.* New Delhi: Tata McGraw Hill
8. **Sasikumar, V & Dhamija, P.V. 1993. *Spoken English - A Self-Learning Guide to Conversation Practice.* New Delhi: Tata McGraw-Hill**
9. *Dixson, Richard J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd*
10. Mukhopadhyay. L *et al. 2012. Polyskills. New Delhi: CUP India Pvt Ltd*
11. Rizvi, M. A. 2005. *Effective Technical Communication.* New Delhi: Tata McGraw Hill
12. *The Hindu Speaks on Education* by the Hindu Newspaper
13. Naterop, B. Jean and Revell, Rod. 2004. *Telephoning in English*. Cambridge: CUP

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STRUCTURAL DYNAMICS

Objectives:
To impart knowledge on the fundamental of structural dynamics and their applications.

Outcomes: The learner will be able to understand the equation of motion, dynamics response of single and multi degree-of freedom systems.

Prerequisites : Structural Analysis I & II

UNIT I:
Theory of vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation - Vibration Isolation -Dynamic magnification factor – Phase angle.

UNIT II
Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis -Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.
Single Degree of Freedom Systems : Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT III
Multi Degree of Freedom Systems : Selection of the degrees of Freedom - Evaluation of structural property matrices - Formulation of the MDOF equations of motion -Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition procedure.

UNIT IV
Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure.
Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

UNIT V
Introduction to Earthquake Analysis: Introduction - Excitation by rigid base translation - Lumped mass approach - SDOF and MDOF systems – Theory of Response Spectrum Method - analysis for obtaining response of multi storeyed buildings.

References:
1. Dynamics of Structures by Clough & Penzien, McGraw Hill, New york
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.
3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 (Part 1) - 2002, "Code of practice for Earthquake resistant design of Structures"

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ADVANCED STEEL DESIGN
(Elective – V & VI)

Objectives:
To impart knowledge on behavior and design of various connections, industrial and steel girders.

Outcomes: The learner will be able to design different steel structures.

Prerequisites : Design of Steel Structures & Structural Analysis

UNIT I:
SIMPLE CONNECTIONS – RIVETED, BOLTED PINNED AND WELDED CONNECTIONS: Riveted Connections – Bolted Connections –Load Transfer Mechanism – Failure of Bolted Joints – Specifications for Bolted Joints – Bearing – Type Connections – Tensile Strength of Plate – Strength and Efficiency of the Joint – Combined Shear and Tension – Slip-Critical connections – Prying Action – Combined Shear and Tension for Slip-Critical Connections. Design of Groove Welds - Design of Fillet Welds – Design of Intermittent Fillet Welds – Failure of Welds.

UNIT II:
ECCENTRIC AND MOMENT CONNECTIONS : Introduction – Beams – Column Connections – Connections Subjected to Eccentric Shear – Bolted Framed Connections – Bolted Seat Connections – Bolted Bracket Connections. Bolted Moment Connections – Welded Framed Connections- Welded Bracket Connections – Moment Resistant Connections.

UNIT III: ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS:
Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; Design of angular roof truss, tubular truss, truss for a railway platform.Design of purlins for roofs, design of built up purlins, design of knee braced trusses and stanchions. Design of bracings.

UNIT IV: DESIGN OF STEEL TRUSS GIRDER BRIDGES:
Types of truss bridges, component parts of a truss bridge, economic Proportions of trusses, self weight of truss girders, design of bridge Compression members, tension members; wind load on truss girder Bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing.

UNIT V: DESIGN OF STEEL BUNKERS AND SILOS :
Introduction – Janssen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom – Design of Bins.

References:
1. Design of Steel Structures. P.Dayaratnam, Publisher : S. Chand, Edition 2011-12.
2. Design Steel Structures Volume – II, Dr. Ramachandra & Vivendra Gehlot Scientitic Publishes Journals Department..
3. Limit State Design of Steel Structures S.K. Duggal Mc Graw Hill Education Private Ltd. NewDelhi.
4. Design of Steel Structures Galyord & Gaylord, Publisher : Tata Mc Graw Hill, Education. Edition 2012.
5. Indian Standard Code – IS – 800-2007.

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DESIGN OF PRESTRESSED CONCRETE STRUCTURES
(Elective – V & VI)

Objectives:
To impart knowledge on basics of prestressing and designing of different structural elements using Prestressing techniques.

Outcomes:
The learner will be able to understand the prestressing techniques, design the various structural elements using Prestressing techniques.

Prerequisites : Reinforced Concrete Design & Structural Analysis

UNIT I:
Introduction – Prestressing Systems – Pretensioning Systems – Postensioning Systems – High Strength Steel and Concrete - Analysis of Prestress - Resultant Stresses at a Section – Pressure Line or Thrust Line – Concept of Load Balancing - Losses of Prestress – Loss Due to Elastic Deformation of Concrete – Shrinkage of Concrete – Creep – Relaxation of Stress in Steel – Friction – Anchorage Slip.

UNIT II:
DEFLECTIONS OF PRESTRESSED CONCRETE MEMBERS : Importance of Control of Deflections – Factors Influencing Deflection – Short-term Deflections of Uncracked Members – Prediction of Long-time Deflections – Deflections of Cracked Members – Requirements of IS 1343-2012.
Ultimate Flexural Strength of Beams: Introduction, Flexural theory using first principles – Simplified Methods – Ultimate Moment of Resistance of untensioned Steel.

UNIT III:
COMPOSITE CONSTRUCTIONS: Introduction, Advantages, Types of Composite Construction, Analysis of Composite beams- Differential shrinkage- Ultimate Flexural and shear strength of composite sections- Deflection of Composite Beams. Design of Composite sections.

UNIT IV:
PRESTRESSED CONCRETE SLABS: Types Of Prestressed Concrete Floor Slabs**-** Design of Prestressed Concrete One Way and Two Way Slabs.
Prestressed Concrete Pipes and Poles : Circular prestressing- Types of Prestressed Concrete Pipes- Design of Prestressed Concrete Pipes - Prestressed Concrete Poles.

UNIT V:
CONTINUOUS BEAMS: Advantage of Continuous Members – Effect of Prestressing Inderterminate Structures – Methods of Achieving Continuity – Methods of Analysis of Secondary Moments – Concordant Cable Profile – Guyon's Theorem. Redistribution of moments in a continuous beam.
Anchorage Zone Stresses in Beams : Introduction, Stress distribution in End Block – Anchorage zone stresses –Magnel's method- Guyon's Method - Anchorage zone Reinforcement.

References :

1. Prestressed Concrete by Krishna Raju – Fifth Edition - Tata Mc Graw Hill Book – Co ., New Delhi.
2. Design of Prestress Concrete Structures by T.Y. Lin and Burn, John Wiley, New York.
3. Prestressed Concrete by N. Rajagopalan, Narosa Publishing House
4. Prestressed Concrete by K.U.Muthu *et al.,* PHI Learning Pvt.Ltd.
5. Prestressed Concrete: Analysis and Design Practice by Karuna Moy Ghosh, Prentice Hall of India
6. IS 1343 -2012, Prestressed Concrete – Code of Practice, Bureau of Indian Standards.

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STABILITY OF STRUCTURES
(Elective – V & VI)

Objectives:
To impart knowledge on the elastic, inelastic buckling and torsional buckling of structures.

Outcomes:
The learner will be able to understand buckling of bars and frames.

Prerequisites : Theory of Elasticity & Advanced Structural Analysis

UNIT – I
Beam Columns: Differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load – application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

UNIT - II
Elastic Buckling of bars and frames: Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns- Buckling of frames-large deflections of buckled bars-Energy methods- Buckling of bars on elastic foundations- Buckle line of bar with intermediate compressive forces - Buckling of bars with change in cross-section – Effect of shear force on critical load- built up columns.

UNIT - III
In Elastic Buckling: Buckle line of straight bar- Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae for design – various end conditions

UNIT - IV
Torsion Buckling: Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section- Torsional buckling – Buckling by torsion and flexure.

UNIT – V
Lateral buckling of simply supported Beams: Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

References
1. Theory of elastic Stability by Timshenko & Gere-Mc Graw Hill
2. Stability of metallic structures by Blunch- Mc Graw Hill
3. Theory of Beam- Columns Vol I by Chem. & Atste Mc. Graw Hill

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COMPOSITE MATERIALS
(Elective – V & VI)

Objectives:
To impart knowledge on the properties of composite materials, their uses and advantages.

Outcomes:
The learner will be able to understand use of different composite materials and design GRP Box beams.

Prerequisites : Reinforced Concrete Design

UNIT - I
Introduction: Requirements of structural materials, influence of nature of materials in structural form, Nature of structural materials- Homogeneous materials, composite materials.

UNIT - II
Macro mechanical Properties of composite Laminae: Introduction, Assumptions and Idealizations, Stress Strain relationships for composite Laminae- Isotropic, Orthotropic laminae, Strength Characteristics- Basic concepts, Strength hypothesis for isotropic and Orthotropic laminae. Macro mechanical Analysis of composite Laminae: Introduction, Assumptions and Limitations, Stiffness characteristics of glass reinforced laminae- Stress-Strain relationships in continuous, discontinuous fibre laminae, Strength characteristics of glass reinforced laminae- Strengths in continuous, discontinuous fibre laminae.

UNIT - III
Behaviour of Glass Fibre-Reinforced laminates: Introduction, Stiffness characteristics of Laminated composites-Behaviour of Laminated beams and plates, Strength characteristics of Laminated composites- Strength analysis and failure criteria, Effect of inter laminar structures. Glass Reinforced Composites: Introduction, Continuously reinforced laminates-uni-directionally and multi directionally continuously reinforced laminates, Discontinuously reinforced laminates – Stiffness and Strength properties.

UNIT - IV
GRP properties relevant to structural Design: Introduction, Short-term strength and stiffness-Tensile, Compressive, Flexural and Shearing. Long term strength and stiffness properties, Temperature effects, Effect of fire, Structural joints- Adhesive, mechanical, Combinational, Transformed sections.

UNIT - V
Design of GRP Box Beams: Introduction, loading, span and cross-sectional shape, Selection of material, Beam manufacture, Beam stresses, Experimental Behaviour, Effect on Beam performance- Modulus of Elasticity, Compressive Strength, I value, prevention of compression buckling failure, Behaviour under long term loading.

Design of Stressed skinned roof structure: Introduction, loading and material properties, preliminary design, and computer analysis.

References:
1. GRP in Structural Engineering M.Holmes and D.J.Just.
2. Mechanics of Composite materials and Structures by Madhujith Mukhopadhyay; Universities Press 2007.

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REHABILITATION AND RETROFITING OF STRUCTURES
(Elective – V & VI)

Objectives:
To impart knowledge about different types of determination of structures testing the structures for the deter ration of structures testing the structures for the diagnosis defects and different types of repairing methods.

Outcomes:
The learner will be understand about different types of distresses in structures, their causes, testing of structures for different problems and suggest suitable repair method.

Prerequisites : Reinforced Concrete Design, Steel Design, Concrete Technology

UNIT – I
Introduction – Deterioration of Structures – Distress in Structures – Causes and Prevention. Mechanism of Damage – Types of Damage.

UNIT – II
Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation.

UNIT – III
Inspection and Testing – Symptoms and Diagnosis of Distress - Damage assessment – NDT.

UNIT – IV
Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

UNIT – V
Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

REFERENCES:
1. Concrete Technology by A.R. Santakumar, Oxford University press
2. Defects and Deterioration in Buildingts, E F & N Spon, London
3. Non-Destructive Evaluation of Concrete Structures by Bungey - Surrey University Press
4. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
5. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)
6. Building Failures : Diagnosis and Avoidance, EF & N Spon, London, B. A. Richardson, (1991).

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CAD LABORATORY

Objectives:
To impart knowledge on the use of various softwares

Outcomes:
The learner will be able to understand and design the structures using the software.

Prerequisites : Advanced Structural Analysis

1. Program for design of slabs. Using Excel
2. Program for design of beams. Using Excel
3. Program for design of column using Excel
4. Analysis of truss using STAAD Pro
5. Analysis of Multistoreyed space frame, using STAAD Pro, ETABS
6. Analysis of Bridge deck slab
7. Analysis of Plane frames using STAAD. Pro.
8. Program for Design of a combined footing using ETABS Excel
9. Program for Design of column using Excel.

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FINITE ELEMENT METHODS

Objectives:
To impart knowledge about various finite element techniques and development of finite element code.

Outcome:
The learner will be able to solve continuum problems using finite element analysis.

Prerequisites : SA- I &II Advanced Structural Analysis

UNIT I
Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles – discrimination - Raleigh - Ritz method of functional approximation.
Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT II
One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions foe ID elements.
Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices

UNIT III
Isoparametric formulation: Concept - different isoparametric elements for 2D analysis - formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements.
Axi Symmetric Analysis: bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements.
Three dimensional FEM: Different 3-D elements-strain-displacement relationship – formulation of hexahedral and isoparametric solid element.

UNIT IV
Introduction to Finite Element Analysis of Plates: basic theory of plate plate bending - thin plate theory - stress resultants - Mindlin's approximations - formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

UNIT V
Introduction to non – linear analysis – basic methods – application to Special structures.

REFERENCES:
1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons Singapour
2. Finite element Methods by OC Zienkiewicz- Tata Mcgraw Hill 2005, 6th Edition
3. Finite element analysis, theory and programming by GS Krishna Murthy Tata Mcgraw Hill 2005, 7th Edition.
4. Introduction to Finite element Method by Tirupathi Chandra Patila and Belugunudu Prentice Hall of India Pvt Ltd - 2007
5. Introduction to Finite element Method by JN Reddy Tata Mcgraw Hill 2005, 3rd Edition

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EARTHQUAKE RESISTANT DESIGN OF BUILDINGS
(Elective – VII & VIII)

Objectives:
To impart knowledge on the seismology and behavior of buildings during earthquakes.

Outcomes : The learner will be able to analyse and design buildings to resist seismic forces.

Prerequisites : Structural Dynamics, Reinforced Concrete Design

UNIT - I
Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics- Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales-Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India.
Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength - Seismic design requirements-regular and irregular configurations-basic assumptions.

UNIT - II
Conceptual Design - Horizontal and Vertical Load Resisting Systems - System and Members for Lateral Loads and High Rise / Tall Structures.
Twisting of Buildings – Flexible Building and Rigid Building Systems.
Strength and Stiffness – Ductility – Definition – Ductility Relationships – Choice of construction Materials – Unconfined Concrete & Confined Concrete – Masonry, Steel Structures. Design Earthquake Loads – Basic Load Combinations – Permissible Stresses.
Seismic Methods of Analysis – Static Method – Equivalent Lateral Force Method. Dynamic Analysis – Response Spectrum Method – Modal Analysis Torsion.

UNIT - III
Introduction to Earthquake Resistant Design – Seismic Design Requirements and Methods.
RC Buildings – IS Code based Method.- Vertical Irregularities – Mass Irregularity Torsional Irregularity - Plan Configuration Problem - Design Lateral Force, Base Shear Evaluation – Lateral Distribution of Base Shear – Structural Walls Strategies and the Location of Structural Walls – Sectional Shapes – Behaviour of Unreinforced and Reinforced Masonry Walls – Behaviour of Walls Box Action and Bands – Behaviour of infill Walls - Non Structural Elements – Failure Mechanism of Nonstructural Elements – Effects of Nonstructural Elements on Structural System – Analysis – Prevention of Damage to Nonstructural Elements – Isolation of Non-Structures.

UNIT - IV
Design of Shear walls: Classification according to Behavior, Loads in Shear walls, Design of Rectangular and Flanged Shear walls, Derivation of Formula for Moment of Resistance of Rectangular Shear walls – Coupled Shear Walls. Introduction to non-linear static Oush Over Analysis.

UNIT - V

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction-Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behavior of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquake- Seismic Evaluation and Retrofitting.

Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

REFERENCES :

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
3. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
4. Masory and Timber structures including earthquake Resistant Design –Anand S.Arya, Nem chand & Bros
5. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial college Press.
6. Design of Reinforced Concrete Structures by N.Subramanian, Oxford University Press.
7. Earthquake Tips – Learning Earthquake Design and Construction C.V.R. Murty

Reference Codes:

1. IS: 1893 (Part-1) -2002. “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.
2. IS:4326-1993, “ Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.
3. IS:13920-1993, “ Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.

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PRINCIPLES OF BRIDGE ENGINEERING
(Elective – VII & VIII)

Objectives:
To impart knowledge about different types of bridges, their analysis and design for combination of different loading condition as per codal provisions.

Outcomes:
The learner will be in a position to understand and design different types of bridges.

Prerequisites : Structural Analysis I &II, Reinforced Concrete Design

UNIT I
Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Seismic loads - Discussion of IRC Loadings - Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of roadway and footway-General Design Requirements –

UNIT II
Solid slab Bridges: Introduction-Method of Analysis and Design.

UNIT III
Girder Bridges: Introduction-Method of Analysis and Design-Courbon's Theory, Grillage analogy

UNIT IV
Pre-Stressed Concrete Bridges: Basic principles-General Design requirements-Mild steel reinforcement in prestessed concrete member-Concrete cover and spacing of pre-stressing steel-Slender beams-Composite Section-Propped-Design of Propped Composite Section-Unproped composite section-Two-stage Prestressing-Shrinking stresses-General Design requirements for Road Bridges – Design of Beams and Expansion Joints.

UNIT V
Design of Bearings: Sub-srtucture of bridges: Substructure- Beds block-Piers- Pier Dimensions- Design loads for piers- Abutments- Design loads for Abutments.

References
1. Essentials of Bridge Engineering by D.Johnson Victor, Oxford and IBH Publishing Co. Pvt. Ltd
2. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani. Khanna Publications 2004
3. Bridge Deck Behaviour by E.C.Hambly.
4. Concrete Bridge Design and Practice by V.K.Raina Tata Mc Graw Hill Publishing co
5. Bridge Engineering by Ponnusamy Tata Mc Graw Hill Publishing co
6. Design of Bridges by N.Krishna Raju, Oxford and IBH Publishing Co. Pvt. Ltd
7. Bridge Engineering by V.V.Sastry, DhanPat Rai & Co.

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PLASTIC ANALYSIS AND DESIGN
(Elective – VII & VIII)

Objectives:
To impart knowledge on the analysis of steel structures like continuous beams, steel frames and connection, using Plastic Analysis.

Outcomes:
The learner will be able to design continuous beams and steel frames.

Prerequisites : Design of Steel Structures & Structural Analysis I & II

UNIT – I
Analysis of Structures for Ultimate Load: Fundamental Principles – statical method of Analysis – Mechanism method of analysis – Method of analysis, Moment check – Carry over factor – Moment Balancing Method.

UNIT - II
Design of Continuous Beams: Continuous Beams of uniform section throughout – Continuous Beams with different cross-sections.

UNIT - III
Secondary Design Problems: Introduction – Influence of Axial force on the plastic moment – influence of shear force – local buckling of flanges and webs – lateral buckling – column stability.

UNIT - IV
Design of Connections: Introduction – requirement for connections – straight corner connections – Haunched connection – Interior Beam-Column connections.

UNIT - V
Design of Steel Frames: Introduction – Sinole span frames – simplified procedures for Sinole span frames – Design of Gable frames with Haunched Connection. Ultimate Deflections: Introduction – Deflection at ultimate load – Deflection at working load – Deflections of Beams and Single span frames.

References:
1. Plastic Design of Steel Frames, L.S.Beedle.
2. Plastic Analysis, B.G.Neal.
3. Plastic Analysis, Horve.

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DESIGN OF INDUSTRIAL STRUCTURES
(Elective – VII & VIII)

Objectives:
To impart knowledge about different types of industrial structures their analysis and design for different conditions as per codal provision.

Outcomes:
The learner will be able to plan different types of industrial structures such as cold framed members, RC buckers, Soil, Chimneys. Cylindrical shells and design them.

Prerequisites : Design of Steel Structures & Structural Analysis

UNIT 1
Planning of Industrial Structures – types of industrial structures – different components of industrial structures – Bracings of Industrial Buildings – Design of Steel Industrial Buildings.

UNIT 2
Thin Walled / Cold Formed Steel Members : Definitions – Local Bucking of Thin-Elements-Post Buckling of Thin-Elements – Light Guage Steel Columns and Compression Members – Form-Factor for Columns and Compression Members – Behaviour of Stiffened Elements Under Uniform Compression – Multiple Stiffened Compression Elements –Effective Length of Light Gauge Steel Compression Members – Light Gauge Steel Tension Members.

UNIT 3
RC Bunkers & Silos : Introduction – Janssen's Theory – Airy's Theory – Design of Square, Rectangular and Circular Bunkers ; Design of Silos.

UNIT 4
RC Chimneys : Introduction – Wind Pressure – Stresses in Chimney Shaft Due to Self-Weight and Wind – Stresses in Horizontal Reinforcement Due to Wind Shear – Stresses Due to Temperature Difference – Combined Effect of Self Load, Wind and Temperature – Temperature Stresses in Horizontal Reinforcement Problems.

UNIT 5
Design Principles of Cylindrical Shells & Design Problems.

References:
1. Advanced Reinforced Concrete Design, By N. Krishna Raju (CBS Publishers & Distributors) 2005.
2. Design of Steel Structures, By Ram Chandra and Virendra Gehlot vol-II, 2007.
3. Design of Steel Structures, By Duggal - Tata McGraw-Hill publishers – 2010

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SEMINAR

Prerequisites: None.

OBJECTIVE:
To understand the topic on thrust area by reviewing about 8-10 research papers and relevant books and material in the website and present the topic and prepare technical report.

OUTCOME:
At the end of the course, the student will be able to undertake a critical review of literature on a chosen topic. Present topics of relevance to a group of professionals. Prepare a technical report.

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COMPREHENSIVE VIVA

Prerequisites: None.

OBJECTIVE:
To test the knowledge gained and to evaluate analyzing skills on the subjects studied in the masters programme.

OUTCOME:
The student will be able to undertake a assimilate knowledge of different courses studied, Develop overall comprehension about Geotechnical Engineering, Analyze real life geotechnical problems with theoretical knowledge learned, Interpret and articulate solutions to real life geotechnical problems.

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Project Phase-I

Prerequisites: None.

OBJECTIVE:
To identify the topic by reviewing literature (Journal/ Conferences/ Articles etc.) and based on the topic, setting objectives and developing methodology to carryout project thesis work

OUTCOME:
The student will be able to identify topics in thrust areas of Geotechnical engineering. Take up critical review of literature on the chosen topic. Carryout independent research work on the topic by experimental / analytical approaches. Documentation and presentation of the research work

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Project Phase – II & Dissertation

prerequisites: None.

OBJECTIVE:
To carryout experimental/analytical programme and critical analysis of results on the identified topic in thrust areas of Geotechnical engineering.

OUTCOME:
Take up critical review of literature on the chosen topic carryout independent research work on the topic by experimental / analytical approaches. Preparation of document and critical analysis of the results of research work and presentation.