# ACADEMIC REGULATIONS
# PROGRAM STRUCTURE
# and
# DETAILED SYLLABUS

## Master of Technology

### ( Structural Engineering )

(Two Year Regular Programme)

(Applicable for Batches admitted from 2015)


GOKARAJU RANGARAJU

INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

# ACADEMIC REGULATIONS

## GOKARAJU RANGARAJU
## INSTITUTE OF ENGINEERING AND TECHNOLOGY

**For all Postgraduate Programmes (M.Tech)**
**GR15 REGULATIONS**

Gokaraju Rangaraju Institute of Engineering & Technology-2015 Regulations (GR 15 Regulations) are given hereunder. These regulations govern all the Post Graduate programmes offered by various departments of Engineering with effect from the students admitted to the programmes from 2015-16 academic year.

1. **Programme Offered:** The Post Graduate programme offered by the department is M.Tech, a two-year regular programme in that discipline.

2. **Medium of Instruction:** The medium of instruction (including examinations and reports) is English.

3. **Admissions:** Admission into the M.Tech Programme in any discipline shall be made subject to the eligibility and qualifications prescribed by the University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in PGCET conducted by the APSCHE for M. Tech Programmes or 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.

4. **Programme Pattern:**
   a) A student is introduced to "Choice Based Credit System (CBCS)" for which he/she has to register for the courses at the beginning of each semesters as per the procedure.
   b) Each Academic year of study is divided into two semesters.
   c) Minimum number of instruction days in each semester is 90.
   d) The total credits for the Programme is 88.
   e) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
   f) A student has a choice of registering for credits from the courses offered in the programme.
   g) All the registered credits will be considered for the calculation of final CGPA.

5. **Award of M.Tech Degree:** A student will be declared eligible for the award of the M. Tech Degree if he/she fulfills the following academic requirements:
   a) A student shall be declared eligible for the award of M.Tech degree, if he/she pursues the course of study and completes it successfully in not less than two academic years and not more than four academic years.

B) A Student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the date of admission, shall forfeit his/her seat in M.Tech courses.

c) The Degree of M.Tech shall be conferred by Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, on the students who are admitted to the programme and fulfill all the requirements for the award of the degree.

**6. Attendance Requirements**

a) A student shall be eligible to appear for the semester end examinations if he/she puts in a minimum of 75% of attendance in aggregate in all the courses concerned in the semester.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in a semester may be granted. A committee headed by Dean (Academic Affairs) shall be the deciding authority for granting the condonation.

c) Students who have been granted condonation shall pay a fee as decided by the Academic Council.

d) A candidate shall get minimum required attendance at least in three theory subjects in the semester to get promoted to the next semester. In order to qualify for the award of M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

E) Students whose shortage of attendance is not condoned in any semester are detained and are not eligible to take their end examinations of that semester. They may seek re-registration for that semester when offered next with the academic regulations of the batch into which he/she gets re-registered.

**7. Paper Setting, Evaluation of Answer Scripts, Marks and Assessment**

a) Paper setting and Evaluation of the Answer Scripts shall be done as per the procedures laid down by the Academic Council of the College from time to time.

b) The following is the division of marks between internal and external evaluations.

| S.no | Particulars | Internal | External | Total |
|---|---|---|---|---|
| 1 | Theory | 30 | 70 | 100 |
| 2 | Practical | 30 | 70 | 100 |
| 3 | Comprehensive Viva | - | 100 | 100 |
| 4 | Seminar | 30 | 70 | 100 |
| 5 | Project work | 30 | 70 | 100 |

c) The marks for internal evaluation per semester per theory course are divided as follows:

i. **For Mid written examinations: 20 Marks**
ii. **For Assignment: 5 Marks**
iii. **For Attendance: 5 Marks**
iv. **Total: 30Marks**

**d) Mid-Term Written Examination:** There shall be two mid-term written examinations during a semester. The first mid-term written examination shall be conducted from the first

50 per cent of the syllabus and the second mid-term written examination shall be conducted from the remaining 50 per cent of the syllabus. The mid-term written examinations shall be evaluated for **20 marks** and average of the marks scored in the two mid-term written examinations shall be taken as the marks scored by each student in the mid-term written examination for that semester.

**e)** **Assignment:** Assignments are to be given to the students and marks not exceeding 5 (5%) per semester per paper are to be awarded by the teacher concerned.

**f)** **Attendance:** A maximum of 5 marks (5%) per semester per course are to be awarded on the basis of attendance one puts in. Course-wise attendance is taken for this purpose.

**g)** **For Internal Evaluation in Practical/Lab Subjects:** The marks for internal evaluation are 30. Internal Evaluation is done by the teacher concerned with the help of the other staff member nominated by Head of the Department. Marks Distribution is as follows:

| | | |
|---|---|---|
| **i.** | **Writing the program/Procedure:** | **10 Marks** |
| **ii.** | **Executing the program/Procedure:** | **10 Marks** |
| **iii.** | **Viva:** | **05 Marks** |
| **iv.** | **Attendance:** | **05 Marks** |
| **v.** | **Total:** | **30Marks** |

**h**) **For External Evaluation in Practical/Lab Subjects:** The Semester end examination shall be conducted by an external examiner and a staff member of the Department nominated by Head of the Department. Marks distribution is as follows:

| | | |
|---|---|---|
| **i.** | **Writing the program/Procedure:** | **20 Marks** |
| **ii.** | **Executing the program/Procedure:** | **20 Marks** |
| **iii.** | **Viva:** | **15 Marks** |
| **iv.** | **Lab Record:** | **15 Marks** |
| **v.** | **Total:** | **70 Marks** |

**i)** **Evaluation of Main Project Work:** A Project Review Committee (PRC) is to be constituted by the Principal/Director with Head of the Department as the Chairman and two other senior faculty members of the department.

**i.** **Registration for Project work:** A candidate is permitted to register for the project work after satisfying the attendance requirements of all the courses (theory and practical courses) up to III Semester.

ii. After satisfying the registration requirements, a candidate is permitted to register for the project work after satisfying, the title, objectives and plan of action of his project work to the Project Review Committee for its approval. Only after obtaining the approval of Project Review Committee of the Department, the student can initiate the project work. Any changes thereafter in the project are to be approved by PRC. The student has to work under the guidance of both internal guide (one faculty member of the department) and external guide (from Industry not below the rank of an officer). Internal guide is allotted by the Head of the Department or Coordinator of the Project Work whereas external guide is allotted by the industrial organization in which the project is undertaken.

iii. The candidate shall submit status of the report in two stages at least with a gap of 20 days between them.

iv. The work on the project shall be initiated in the beginning of the fourth semester and the duration is one semester. A candidate is permitted to submit project report only after successful completion of theory and practical courses with the approval of PRC and not earlier than 40 days from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of the thesis to the Head/Coordinator (through internal research guide) and shall make an oral presentation before the PRC.

v. Two hardcopies and one soft copy of the project work (dissertation) certified by the research supervisors shall be submitted to the College/Institute.

vi. The thesis shall be adjudicated by one external examiner selected by the Institute out of 5-member panel, submitted by the department.

vii. The marks allotted for project work review are 100, out of which30 are for internal and 70 for external. Internal evaluation marks are awarded by the PRC on the basis of the student's performance in the three pre-submission reviews and the external evaluation is done by the external examiner.

viii. The marks allotted for project work and dissertation are 100, out of which 30 are for internal and 70 for external. Internal evaluation marks are awarded by the PRC on the basis of the student's performance in the three pre-submission reviews and the external evaluation is done by the external examiner. In both internal and external evaluations the student shall score at least 40% marks and an aggregate of 50% marks to pass in the project work. If the report of the examiner is favorable, Viva-voce examination shall be conducted by a Board consisting of the Supervisor, Head and the External Examiner who adjudicated the project work. The Board shall jointly evaluate the student's performance in the project work.

ix. In case the student doesn't pass through the project work, he has to reappear for the viva-voce examination, as per the recommendations of the Board. If he fails succeed at the second Viva-voce examination also, he will not be eligible for the award of the degree, unless he is asked to revise and resubmit the Project by the Board. Head of the Department and Project coordinator shall coordinate and make arrangements for the conduct of viva-¬voce examination. When one does get the required minimum marks both in internal and external evaluations the candidate has to revise and resubmit the dissertation in the time frame prescribed by the PRC. If the report of the examiner is unfavorable again, the project shall be summarily rejected.

x. If the report of the viva-voce is not satisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, he will not be eligible for the award of the degree, unless the candidate is asked to revise and resubmit.

8. **Recounting of Marks in the End Examination Answer Books:** A student can request for re-counting of his/her answer book on payment of a prescribed fee.
9. **Re-evaluation of the End Examination Answer Books:** A student can request for re-evaluation of his/her answer book on payment of a prescribed fee.
10. **Supplementary Examinations:** A student who has failed in an end semester examination can appear for a supplementary examination, as per the schedule announced by the College/Institute.

**11. Malpractices in Examinations:** Disciplinary action shall be taken in case of malpractices during Mid/ End-examinations as per the rules framed by the Academic Council.

**12. Academic Requirements**

a) A student shall be deemed to have secured the minimum academic requirement in a subject if he / she secures a minimum of 40% of marks in the Semester-end Examination and a minimum aggregate of 50% of the total marks in the Semester-end examination and Internal Evaluation taken together.

b) A student shall be promoted to the next semester only when he/she satisfies the requirements of all the previous semesters.

c) In order to qualify for the award of M.Tech Degree, the student shall complete the academic requirements of passing in all the Courses as per the course structure including Seminars and Project if any.

d) In case a Student does not secure the minimum academic requirement in any course, he/she has to reappear for the Semester-end Examination in the course, or re-register for the same course when next offered or re-register for any other specified course, as may be required. However, one more additional chance may be provided for each student, for improving the internal marks provided the internal marks secured by a student are less than 50% and he/she failed finally in the course concerned. In the event of taking another chance for re-registration, the internal marks obtained in the previous attempt are nullified. In case of re-registration, the student has to pay the re-registration fee for each course, as specified by the College.

**E) Grade Points:** A 10- point grading system with corresponding letter grades and percentage of marks, as given below, is followed

| Letter Grade | Grade Point | Percentage of Marks |
|---|---|---|
| O (Outstanding) | 10 | Marks>=80 and Marks <= 100 |
| A+ (Excellent) | 9 | Marks>=70 and Marks < 80 |
| A (Very Good) | 8 | Marks>=60 and Marks < 70 |
| B+ (Good) | 7 | Marks>=55 and Marks < 60 |
| B (Above Average) | 6 | Marks>=50 and Marks < 55 |
| F (Fail) | 0 | Marks < 50 |
| Ab (Absent) | 0 | |

**Earning of Credit:**

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range O-P. Letter grade 'F' in any Course implies failure of the student in that course and no credits earned.

**Computation of SGPA and CGPA:**

The UGC recommends the following procedure to compute the Semester Grade Point

Average (SGPA) and Cumulative Grade Point Average (CGPA):

i) Skthe SGPA of kth semester(1 to 4) is the ratio of sum of the product of the number of credits and grade points to the total creditsof all courses registered by a student,

$$\text{SGPA } (S_k) = \sum_{i=1}^{n} (Ci * Gi) / \sum_{i=1}^{n} Ci$$

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course and n is the number of courses registered in that semester.

ii) The CGPA is calculated in the same manner taking into account all the courses m, registered by a student over all the semesters of a programme, i.e., upto and inclusive of Sk, where k ≥ 2.

$$\text{CGPA} = \sum_{i=1}^{m} (Ci * Gi) / \sum_{i=1}^{m} Ci$$

iii) The SGPA and CGPA shall be rounded off to 2 decimal points.

13. **Award of Class:** After a student satisfies all the requirements prescribed for the completion of the Degree and becomes eligible for the award of M. Tech Degree by JNTUH, he/she shall be placed in one of the following four classes:

| | Class Awarded | CGPA Secured |
|---|---|---|
| 3.1 | First class with distinction | CGPA ≥ 7.75 |
| 3.2 | First Class | CGPA ≥ 6.75 and CGPA < 7.75 |
| 3.3 | Second Class | CGPA ≥ 6.00 and CGPA < 6.75 |

14. **Withholding of Results:** If the student has not paid dues to the Institute/ University, or if any case of indiscipline is pending against him, the result of the student (for that Semester) may be withheld and he will not be allowed to go into the next Semester. The award or issue of the Degree may also be withheld in such cases.

15. **Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/ Universities:** Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/ Universities shall be considered only on case-to-case basis by the Academic Council of the Institute.

16. **Transitory Regulations:** Students who have discontinued or have been detained for want of attendance, or who have failed after having undergone the Degree Programme, may be considered eligible for readmission to the same or equivalent subjects as and when they are offered.

17. **General Rules**
    a) The academic regulations should be read as a whole for the purpose of any interpretation.
    b) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.
    c) In case of any error in the above rules and regulations, the decision of the Academic Council is final.
    d) The college may change or amend the academic regulations or syllabi at any time and the

changes or amendments made shall be applicable to all the students with effect from the dates notified by the college.

**M.Tech (STE)** **M.Tech (STE) PROGRAMME STRUCTURE** **I Year-I Semester**

| Sub-Code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR15D5152 | PC | Theory of elasticity and plasticity | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5153 | PC | Theory and analysis of plates | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5154 | PC | Advanced Reinforced concrete design | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **OE-I** | **Open Elective – I** | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **Elective I** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5155 | PE | Advanced Concrete Technology | | | | | | | |
| GR15D5156 | PE | Experimental stress analysis | | | | | | | |
| GR15D5157 | PE | Optimization techniques in structural Engineering | | | | | | | |
| | **Elective II** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5158 | PE | Matrix Methods in Structural Analysis | | | | | | | |
| GR15D5159 | PE | Soil dynamics and machine foundation | | | | | | | |
| GR15D5160 | PE | Fibre reinforced cement concrete | | | | | | | |
| GR15D5161 | Lab | Advanced Concrete Lab | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| GR15D5173 | SPW | Seminar – I | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| | | **Total** | **18** | **6** | **4** | **28** | **240** | **560** | **800** |

**M.Tech (STE)** **M.Tech (STE) PROGRAMME STRUCTURE** **I Year-II Semester**

| Sub-Code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR15D5162 | PC | Finite element methods in Structural Engineering | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5163 | PC | Structural dynamics | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5165 | PC | Advanced steel design | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **OE-I** | **Open Elective – I** | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| | **Elective III** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5166 | PE | Advanced Pre-stressed Concrete | | | | | | | |
| GR15D5168 | PE | Computer Aided design in Structural Engineering | | | | | | | |
| GR15D5167 | PE | Advanced design of structures | | | | | | | |
| | **Elective IV** | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5169 | PE | Principles of bridge Engineering | | | | | | | |
| GR15D5164 | PE | Analysis and design of shells and folded plates | | | | | | | |
| GR15D5170 | PE | Earthquake resistant design of buildings | | | | | | | |
| GR15D5172 | Lab | Advanced CAD lab | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| GR15D5174 | SPW | Seminar – II | 0 | 0 | 2 | 2 | 30 | 70 | 100 |
| | | **Total** | 18 | 6 | 4 | 28 | 240 | 560 | 800 |

### II Year-I Semester

| Sub-code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR15D5175 | SPW | Comprehensive Viva-voce | - | - | - | 4 | 0 | 100 | 100 |
| GR15D5176 | SPW | Project work Review | - | - | - | 12 | 30 | 70 | 100 |
| | | Total | - | - | - | 16 | 30 | 170 | 200 |

### II Year-II Semester

| Sub- code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR15D5177 | SPW | Project work and Dissertation | - | - | - | 16 | 30 | 70 | 100 |
| | | Total | - | - | - | 16 | 30 | 70 | 100 |

A student has a choice to select one Open Elective Pool I in I Semester and one Open Elective Pool II in II Semester.

**Open Elective Pool-I**

| Sub-code | Group | Subject | L | T | P | C | Int. | Ext. | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR15D5178 | OE-I | E- Commerce and Applications (CSE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5179 | | Enterprise Resource Planning (IT) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5180 | | Modern Control Theory (EEE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5181 | | Computer Oriented Numerical Methods in Engineering (CE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5182 | | Advanced Computer Architecture (ECE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5183 | | Operations Research (ME) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |

**Open Elective Pool-II**

| Sub-Code | Group | Subject | L | T | P | C | Int | Ext | Total |
|---|---|---|---|---|---|---|---|---|---|
| GR15D5184 | OE-II | Human Computer Interaction (CSE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5185 | | Big Data and Analytics (IT) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5186 | | Neural and Fuzzy Systems (EEE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5187 | | Project Management (CE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5188 | | Hardware Software Co-Design(ECE) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| GR15D5189 | | Non-Conventional Energy Resources(ME) | 3 | 1 | 0 | 4 | 30 | 70 | 100 |

# I- SEMESTER

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## THEORY OF ELASTICITY AND PLASTICITY

M.Tech (STE) I Year - I Semester
Course Code: GR15D5152 L/T/P/C: 3/1/0/4

### PREREQUISITES

- Knowledge in Mechanics of Solids
- Exposure to Advanced engineering mathematics

### COURSE OBJECTIVES

- To gain comprehensive knowledge about stresses and strains and their relations in linear elasticity
- To familiarize with the solutions to2-D problems of elasticity in Cartesian and polar coordinates.
- To analyze stresses and strains in 3-D problems of elasticity in Cartesian and polar coordinates.
- To acquire knowledge about torsion and bending of prismatic bars with various cross-sections.
- To introduce to theory of plasticity and failure theories.

**COURSE OUTCOMES:** After completion of this course students will be able to

- Explain the basic concepts of stress-strain relations in theory of elasticity
- Analyse and interpret stresses and strains in 2-Dand 3-D problems of elasticity in Cartesian coordinate system.
- Analyse and interpret stresses and strains in 2-D and 3-D problems of elasticity in polar coordinate system.
- Apply general theorems to find solutions to problems of elasticity.
- Find the solutions to torsional problems using principles of elasticity
- Find the solutions to bending problems using soap film method
- Explain various theories of failures in plasticity.

### UNIT - I

**Introduction:** Elasticity - notation for forces and stresses - components of stresses - components of strain – Hook's law. Plane stress and plane strain analysis - plane stress - plane strain – differential equations of equilibrium - boundary conditions - compatibility equations - stress function – boundary condition.

### UNIT - II

Two dimensional problems in rectangular coordinates - solution by polynomials - Saint- Venant's principle - determination of displacements - bending of simple beams - application of fourier series

for two dimensional problems - gravity loading. 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 - simple symmetric and asymmetric problems - general solution of two- dimensional problem in polar coordinates - application of general solution in polar coordinates.

**UNIT - III**

Analysis of stress and strain in three dimensions - principal stresses - stress ellipsoid - director surface - determination of principal stresses - max shear stresses – 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.

**UNIT - IV**

Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes , bars etc. Bending of Prismatic Bars: Stress function - bending of cantilever – circular cross section - elliptical cross section - rectangular cross section - bending problems by soap film method - displacements.

**UNIT - V**

**Theory of Plasticity:** Introduction - concepts and assumptions - yield criterions.

**TEXT BOOKS**

1. J.N. Goodier, Stephen Timoshenko, Theory of Elasticity (Third Edition), Tata Mc Graw-Hill Education Pvt. Ltd.(2010)
2. J.Chakarbarthy, Theory of Plasticity, McGraw-hill Publications, 1987.

**REFERENCE BOOKS**

1. Y.C.Fung, An Introduction to the Theory of Aeroelasticity
2. Dr Sadhu Singh, Theory of Elasticity, Khanna Publishers.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## THEORY AND ANALYSIS OF PLATES

M.Tech (STE) I Year - I Semester

Course Code: GR15D5153 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** Students will be able to

- Achieve fundamental understanding of the classical theory of elastic plates
- Introduce analytical and Numerical solution techniques in thin plate theory
- Apply theory of plates to the problems involving various geometrics and boundary conditions
- Apply Navier and Levi's method to plates with different end conditions.
- Provide enhanced knowledge in solid mechanics and advanced structural mechanics.

**COURSE OUTCOMES:** On successful completion of this course, it is expected that students should be able to

- Analyze bending of plates.
- Understand small deflection theory and Analyze plates using Navier method.
- Analyze plates using Levi's method.
- Analyze Circular plates.
- Analyze Orthotropic plates.
- Analyze plates on elastic foundation.
- Analyze buckling of plates.

**UNIT - I**

**Cylindrical Bending:** Different kind of plates – Assumptions - Derivation of differential equation for cylindrical bending of long rectangular plates - Analysis of uniformly loaded rectangular plates with edges simply supported and fixed subjected to uniform load.

**Pure Bending of Plates:** Slope and curvature of slightly bent plates – Relations between moments and curvature - Particular cases of pure bending - Strain energy in pure bending –Energy methods like Ritz and Galerkin Methods to rectangular plates subjected to simple loadings.

**UNIT - II**

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

**UNIT - III**

**Circular Plates :** Symmetrical loading – Relations between slope, deflection, moments and curvature – Governing differential equation – Uniformly loaded plates with clamped and simply

supported edges – Central hole – bending by moments and shearing forces uniformly distributed.
**Orthotropic Plates:** Introduction – Bending of anisotropic plates - Derivation of governing differential equation – Determination of Rigidities in various cases like R.C. slabs, corrugated sheet
– Application to the theory of grid works.

**UNIT - IV**

**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 loads P.

**UNIT - V**

**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
**Finite Difference Methods:** Introduction - Application to rectangular plates subjected to simple loading.

**TEXT BOOKS**

1. Timoshenko, Theory of Plates and Shells, McGraw Hill Book Co., New York, 2nd edition, 2003.
2. P. Szilard, Theory and Analysis of Plates, Prentice Hall, 1973.

**REFERENCE BOOKS**

1. Chandrasekhar, Theory of Plates, University Press, 2001.
2. N. K. Bairagi, Plate Analysis, Khanna Publishers, New Delhi, 1986.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED REINFORCED CONCRETE DESIGN

M.Tech (STE) I Year - I Semester

Course Code: GR15D5154 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** On completion of this Subject/Course, following objectives shall get accomplished:

- To provide students about the design of structures with an acceptable probability and performing satisfactorily during their intended life
- To train the students about the design of structure which sustain all loads and deform within the limits.
- To make understand the students about the design of structure which is durable.
- To make understand the students about the design of structure which adequately resists the affects of misuse and fire.
- To train the students about the detailing of structures.
- To train the students about teaching of structural design to UG & PG students.
- To motivate the students about the Research Development activities of RCC which results in durable and economical structures.

**COURSE OUTCOMES:** On completion of this Subject/Course the student shall be able to:

- Design the reinforced concrete structures with an acceptable probability and performing satisfactorily during their intended life by using Limit state method of design & IS 456:2000.
- Design the reinforced concrete structures which sustain all loads and deform within the limits.
- Design the reinforced concrete structures which are durable by properly detailing the reinforcement.
- Design the reinforced concrete BEAMS including DEEP BEAMS for the given loads and moments
- Design the reinforced concrete COLUMNS & COMBINED FOOTINGS for the given loads and moments
- Design the reinforced concrete FLAT SLABS & RIBBED SLABS for the given loads.
- Design the reinforced concrete CORBELS for the given loads and moments

**UNIT - I**

**Over View of Reinforced concrete design:** Behaviour in flexure, Design of singly reinforced rectangular sections, Design of doubly reinforced rectangular sections, Design of flanged beams, Design for shear, Design for Torsion, Limit state of Serviceability: Deflections of Reinforced concrete beams and slabs, short term deflection 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, and 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.

**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 with Uniaxial Bending, Design of Short Columns under Biaxial Bending, Design of Slender Columns.
Design of Combined Footings- Distribution of soil Pressure – Geometry of Two Column Combined Footing – Design Considerations in Combined Footing for Two – Columns.

**TEXT BOOKS**

1. S. Unnikrishna Pillai & Menon, Reinforced concrete design, Tata Mc. Graw Hill, 2nd Edition, 2004.
2. P.C.Varghese, Advanced Reinforced Concrete Design, Preintice Hall, 2008.
3. Dr. S.R. Karve and Dr. V.L. Shah, Limit state theory and design of reinforced concrete, Standard publishers, Pune, 3rd Edition, 1994.
4. N.Krishna Raju, Advanced Concrete Design.

**REFERENCE BOOKS**

1. KennathLeet, Reinforced concrete design, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
2. P.Purushotham, Reinforced concrete structural elements – behaviour, Analysis and design, Tata Mc.Graw-Hill, 1994.
3. Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Design of concrete structures, Tata Mc. Graw-Hill, 3rd Edition, 2005.
4. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Reinforced concrete structures, Vol.1, by, Laxmi Publications, 2004.
5. I.C. Syal& A.K. Goel, Reinforced concrete structures, S. Chand, 2004.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED CONCRETE TECHNOLOGY
## (ELECTIVE-)

M.Tech (STE) I Year - I Semester

Course Code: GR15D5155 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To study the physical and chemical properties of cement and admixtures. And also to know about hydration and SEM analysis.
- To study the properties and conduct the tests on fresh and hardened concrete.
- To acquire the practical knowledge on mix design principles, concepts and methods.
- To get an adequate knowledge about the special concretes and their applications in the diverse construction field.
- To design the forms of different materials for the different types of works under different conditions.

**COURSE OUTCOMES:** Students should be able to:

- List out the types of cement, admixture and decide the suitable cement and admixture for specific purpose.
- Determine the properties of concrete ingredients i.e. cement, fine aggregate and coarse aggregate by conducting different tests.
- Recognize the effects of the rheology and early age properties of concrete on its long-term behavior
- Conduct the different workability tests on conventional and self compacted concrete (fresh concrete) and recognize the importance of durability of hardened concrete.
- Design the mix proportion of ordinary, standard and high strength concrete by using different methods and how the strength of concrete can be modified by changing the proportions.
- Decide suitable concrete for different structures considering the prevailing weathering conditions and Design economic concrete mix proportion for different exposure conditions and intended purposes with normal concrete.
- Design the forms for a specific work and decide the time of removal of forms for the different elements in different situations.

### UNIT – I

**Concrete Making Materials:** Cement- Bogues compounds – Hydration process– Alkali silica reaction -Admixtures – Chemical and Mineral admixtures. Studies on Micro structure of concrete and applications of SEM (Scanned Electronic Microscope)

**UNIT – II**

**Fresh and Hardened Concrete:** Fresh Concrete - Workability tests on Concrete, setting times of Fresh Concrete - Segregation and bleeding.
**Hardened Concrete:** Abram's law- Gel space ratios, Maturity Concept – Stress Behaviour – Creep and Shrinkage – Durability tests on concrete - Non destructive testing of concrete.

**UNIT - III**

**Special Concretes:** Self Compacting concrete – Polymer concrete – Fiber reinforced concrete –Reactive Powder concrete – Requirements and Guidelines – Advantages and Applications. Light weight concrete, Bacterial concrete
**Concrete mix design:** Quality Control - Quality assurance - Quality audit- Mix Design method - BIS method, ACI method, DOE method, Mix Design for Blended concretes

**UNIT –IV**

High Strength Concrete –Use of Nano materials – Manufacturing and Properties- Design of HSC Using ErintroyShaklok Method- Ultra High Strength Concrete.
High Performance Concrete- Requirements and properties of High Performance Concrete- Design Considerations.

**UNIT –V**

Form work for concrete – materials – structural requirements – form work systems – connections – specifications – slip forms, permanent form work, latest form work– design of form work – shores – removal of forms – reshoring – failure of form work-case studies

**TEXT BOOKS**

1. A.M.Neville, Properties of Concrete, ELBS publications, 4th pointing DECLO, 1996.
2. A.K. Santhakumar, Concrete Technology, Oxford Press, 2002.
3. M.S.Shetty, Concrete Technology, S.Chand& Co, 2005.

**REFERENCE BOOKS**

1. Rajat Siddique, Special Structural concretes, Galgotia Publications, 3rd edition, 1994.
2. N.Krishna Raju, Design of Concrete Mixes, CBS Publications, 2014.
3. P.K.Mehta, Concrete: Micro Structure, ICI, Chennai.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## EXPERIMENTAL STRESS ANALYSIS
## (ELECTIVE-I)

M.Tech (STE) I Year - I Semester

Course Code: GR15D5156 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To understand the relation between the mechanics theory and experimental stress analysis.
- To establish the fundamental concepts and newly experimental techniques.
- To be able to make a fine presentation related to the experimental paper able to use the experimental techniques on the practical problems

**COURSE OUTCOMES:** By the end of this course, student should be able to

- Understand theory of elasticity for planes and principles of experimental approach to analyse stress and strain.
- Understand the physical processes enabling strain to be measured by use of electrical resistance strain gages and photo elasticity,
- Obtain useful strain measurement data using strain gages and photo elasticity,
- Awareness of strain gauge characteristics that enter into gauge selection and performance and familiarity with photo elastic material properties, including 2D photo elasticity.
- Calculate stress from strain measurements,
- Have knowledge on brittle coating methods
- Convey information regarding designing, carrying out and reporting results of experiments

### 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, The Plane-Strain Approach, Plane Stress, Airy's Stress function-Cartesian Co-ordinates-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.

**TEXT BOOKS**

1. Dr. Sadhu Singh, Experimental Stress Analysis, 3rd edition, Mc Graw Hill, 1991.
2. J.W.Dally and W.F.Riley, Experimental Stress Analysis, Mc Graw Hill, 1991.

**REFERENCE BOOKS**

1. Dove and Adams, Experimental Stress Analysis, 1st edition, 1964.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## OPTIMIZATION TECHNIQUES IN STRUCTURAL ENGINEERING (ELECTIVE-I)

M.Tech (STE) I Year - I Semester
Course Code: GR15D5157 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To introduce the fundamentals of optimization concepts and their applications in the structural engineering field.
- To study the linear programming methods of the optimization.
- To know the constrained and unconstrained variables of the various structural engineering problems.
- To know the various methods of optimization involving geometric and dynamic programming.
- To have an exposure on the various advanced techniques in the structural optimization.

**COURSE OUTCOMES:** By the end of this course, student should be able to

- Aply the basic ideas in optimization to make the structures .
- Apply the linear programming techniques in engineering optimization.
- Solve the unconstrained and constrained optimization problems in structural design.
- Understand the methods in solving the problems related to geometric and dynamic Programming.
- To have a knowledge in advanced techniques of optimization graph theory and network analysis.
- To have a knowledge in non-linear programming.
- Apply optimization techniques to basic structural elements.

### 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 methos - 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.

**TEXT BOOKS**

1. S.S.Rao, Optimization: Theory and Applications.
2. G. N.Vanderplaats, Numerical Optimization Techniques for Engineering Design with applications.

**REFERENCE BOOKS**

1. R.T.Haftka and Z.Gurdal, Elements of Structural Optimization.
2. U.Kirsch, Optimum Structural Design.
3. K.I.Majid, Optimum Design of Structures.
4. J.S.Arora, Introduction to Optimum Design.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## MATRIX METHODS IN STRUCTURAL ANALYSIS

## ELECTIVE -II

M.Tech (STE) | I Year - I Semester
Course Code: GR15D5158 | L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- The student should learn how to idealize and analyse statically determinate and indeterminate structures.
- The student should learn how to idealize kinematic ally determinate and indeterminate structures.
- Familiarity with professional and contemporary issues.
- To understand the effective usage of matrix methods.
- Understand the effectiveness shear walls in constructions.

**CORSE OUTCOMES:** On Successful completion of the course, student should be able to

- Determine the static in-determinacy and kinematic in-determinacy of structures.
- Develop a flexibility and Stiffness matrices according to SID and KID's.
- Develop flexibility and stiffness matrices for truss and beam elements.
- Analyse statically indeterminate structures by using Flexibility matrix method.
- Analyse kinematic ally indeterminate structures by using stiffness matrix method.
- Apply the matrix methods in indeterminate structure and how to prepare a computer algorithm.
- Understand the usage of shear walls in multistoried constructions.

### UNIT - I

Introduction to matrix methods of analysis - static indeterminacy and kinematic 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 tensional 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 - Rank matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

### UNIT - III

Analysis of plane truss - continuous beam - plane frame and grids by flexibility methods.

**UNIT - IV**

Analysis of plane truss - continuous beam - plane frame and grids 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.

**TEXT BOOKS**

1. William Weaver J.R and James M.Geve, Matrix Analysis of Frames structures, CBS publications, Delhi 2004.
2. Ashok.K.Jain, Advanced Structural Analysis, New Channel Brothers, 1996.
3. C.S.Reddy, Structural Analysis, 3rd edition, 2010.

**REFERENCE BOOKS**

1. Kanchi, Matrix Structural Analysis, 1995.
2. J.Meek, Matrix Methods of Structural Analysis, 3rd edition, 1980.
3. Ghali and Neyveli, Structural Analysis, 3rd edition , December, 1990.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## SOIL DYNAMICS AND MACHINE FOUNDATIONS
## ELECTIVE- II

M.Tech (STE) I Year - I Semester
Course Code: GR15D5159 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** The objectives of this course will help the student to

- Prepare the students about fundamentals of soil dynamics.
- Educate the students with the dynamic properties of soil.
- Provide various concepts that is used in vibration analysis.
- Educate about different types of foundations for reciprocating and impact machines.
- Prepare the students about the importance of designing machine foundations.

**COURSE OUTCOMES:** At the end of the course, the students will be able to

- Identify and outline the fundamentals of soil dynamics.
- Distinguish between different types of dynamic soil properties and their experimental determination.
- Discuss various concepts of soil dynamics for vibration analysis.
- Differentiate various types of machine foundations.
- Express the design criteria for machine foundations.
- Assess principles of design of foundation for reciprocating and impact type of machines.
- Find methods of isolating materials and their properties.

**UNIT - I**

**Introduction to soil dynamics:** Fundamentals of vibration, natural frequency, resonance, simple harmonic motion, free and forced vibrations, single and multi degree freedom systems, Rayleighs method of fundamental frequency, logarithmic decrement, damping, transmissibility, vibrating measuring instruments.

**UNIT - II**

**Dynamic soil properties:** Elastic properties, experimental determination, elastic waves and their characteristics, shear modulus.

**UNIT - III**

**Vibration analysis:** Apparent soil mass, pressure bulb concept, Pauw's analogy of foundation-soil systems (Concept only), theory of elastic half space, lamb and the dynamic Boussinesq's problem, Relsner's solution and its limitations, Quinlan and Sung's modifications, Hsiegh's equations for vertical vibration.

**UNIT - IV**

**Types of machine foundations:** bearing pressure, constant force vibrations. General requirements, design criteria, permissible amplitudes, and rotating mass type excitation, magnification steady state

.

**UNIT - V**

**Design of machine foundations:** Principles of design of foundations for reciprocating and impact type of machine as per I.S. Codes, Vibration isolation, types and methods of isolation, isolating materials and their properties.

**TEXT BOOKS**

1. Braja M. Das and G.V.Ramana, Principles of soil dynamics, Cengage Learning, 2nd Edition, 2011.
2. Dr.Swami Saran, Soil dynamics and machine foundations, Galgotia Publications, 2nd edition, 2nd Reprint, 2010.

**REFERENCE BOOKS**

1. Prakash S and Puri V. K., Analysis and design of machine foundations, McGraw Hill, New York, 1993.
2. Srinivasulu P and Vidyanathan C.V., Hand Book of Machine Foundations, Tata McGraw Hill, New Delhi, 1981.
3. Richart, F.E.Mall J.R and Woods R. D., Vibration of soils and foundations, Prentice Hall Inc., 1970.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## FIBRE REINFORCED CEMENT CONCRETES
## ELECTIVE II

M.Tech (STE) I Year - I Semester
Course Code: GR15D5160 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVE

- Stiffness & Strength properties of fibre reinforced Concrete.
- Short term Strength, Long term Strength properties of GRP properties.
- To provide good understanding about behaviour of glass fibre reinforced laminates.
- To introduce design of GRP box beams.
- To understand the behaviour of loading, span and C/S Shape.

**COURSE OUTCOMES:** At the end of the course, students should be able to

- Know about the GRP in detail.
- Understand the application of GRP properties relevant to Structural design.
- Stress Strain relationship in continuous and discontinuous fibre laminae.
- Stiffness & Strength properties of fibre reinforced Concrete.
- Identify, formulate & design of GRP box becomes.
- Short term & long term Strength & Stiffness properties.
- Long term loading, buckling failures of GRP box beams.

### 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.

**TEXT BOOKS**

1. M.Holmes and D.J.Just, GRP in Structural Engineering, Dec 1983.
2. Dr.V.SGangadhrar& Dr.Vijay, Fibre Reinforced Concrete.

**REFERENCE BOOKS**

1. ManjunathMukhopadhyay, Mechanics of Composite materials and Structures, Universities Press.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED CONCRETE LAB

M.Tech (STE) I Year - I Semester

Course Code: GR15D5161 L/T/P/C: 0/0/2/2

### COURSE OBJECTIVES

- To familiarize the students with physical and mechanical properties of cement concrete constituents.
- To provide practical knowledge and understanding towards the materials used for concrete.
- To provide exposure about the fresh and hardened concrete.
- To acquire practical skills in the area of cement, fresh and hardened concrete testing.
- To give good understanding about water to be added to cement for various purposes.
- To provide exposure about self compacting concrete.

**COURSE OUTCOMES:** On completion of the course, students should be able to

- Identify the suitable materials used for concrete for particular purpose.
- Gauge the quality control of concrete.
- Carry out the laboratory tests relevant to the use of concrete on site
- Understand the theoretical concepts learned in the courses concrete technology and building materials and construction planning.
- Design concrete mix for particular grade of concrete
- Test the concrete for various loading conditions
- Do the non-destructive testing.

1. Tests on cement - Consistency, Setting times, Soundness, Compressive Strength.
2. Gradation Charts of Aggregates.
3. Bulking of fine Aggregate.
4. Aggregate Crushing and Impact value
5. Workability Tests on Fresh self compacting concrete
6. Air Entrainment Test on fresh concrete.
7. Marsh cone test.
8. Permeability of Concrete.
9. Non Destructive Testing of Concrete.
10. Accelerated Curing of Concrete.
11. Influence of W/C ratio on strength and Aggregate / Cement ratio on workability and Strength
12. Influence of Different Chemical Admixtures on concrete.

# OPEN ELECTIVE - I

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## E - COMMERCE AND APPLICATIONS
## (Open Elective I)

M.Tech (CSE) I Year - I Semester

Course Code: GR15D5178 L/T/P/C: 3/1/0/4

**Course Objectives**

- To understand the interest and opportunity of e-commerce
- To know and understand the critical success factors in implementing an ecommerce
- System
- To know how to plan and how to manage e-commerce solutions
- To have hands on, real-life experience with electronic commerce applications
- To analyze and understand the human, technological and business environment
- Associated with e-commerce

**Course Outcomes:** At the end of the course, the student will be able to

- Understand the trends in e-Commerce and the use of the Internet.(Level 2)
- Analyze, Understand and Comparethe principles of E-commerce and basics of World Wide Web.(Level 2&4)
- Analyze, Understandthe concept of electronic data interchange and its legal, social and technical aspects.(Level 2&4)
- Understandand Evaluate the security issues ssssover the web, the available solutions and future aspects of e-commerce security .(Level 2&5)
- Understanding and Validating the concept of E-banking, electronic payment system.(Level 2&5)
- Understand, Analyze and Comparethe capabilities and limitation of agents, Web based marketing and various security Issues. (Level 2&4)
- Understandingand Evaluation of online advertisements, website design issues and Creating a business transaction using an e commerce site.(Level 2,5 &6)

**UNIT-I**

**INTRODUCTION** Traditional commerce and E commerce – Internet and WWW – role of WWW – value chains – strategic business and Industry value chains – role of E commerce, advantages of E commerce, anatomy of e commerce applications.

**UNIT-II**

**INFRASTRUCTURE FOR E COMMERCE** Packet switched networks – TCP/IP protocol script – Internet utility programmes – SGML, HTML and XML – web client and servers – Web client/server architecture – intranet and extranets.

**UNIT-III**

**WEB BASED TOOLS FOR E COMMERCE** Web server – performance evaluation - web server software feature sets – web server software and tools – web protocol – search engines – intelligent agents –EC software – web hosting – cost analysis

**UNIT- IV**

**SECURITY** Computer security classification – copy right and Intellectual property – electronic commerce threats – protecting client computers – electronic payment systems and risks involved in it –electronic cash __ micro payment system– strategies for marketing – sales and promotion – cryptography –authentication.

**UNIT-V**

**INTELLIGENT AGENTS** Definition and capabilities – limitation of agents – security – web based marketing – search engines and Directory registration – online advertisements – Portables and info mechanics – website design issues.

**TEXT BOOKS**

1. Ravi Kalakota, " Electronic Commerce", Pearson Education,
2. Gary P Schneider "Electronic commerce", Thomson learning & James T Peny Cambridge USA, 2001.

**REFERENCES BOOK**

1. EfraimTurvanJ.Lee, David kug and chung, "Electronic commerce" Pearson Education Asia 2001.
2. Brenda Kienew E commerce Business Prentice Hall, 2001.
3. Manlyn Greenstein and Miklos "Electronic commerce" McGraw-Hill, 2002.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ENTERPRISE RESOURCE PLANNING
## (Open Elective-I)

M.Tech (IT) I Year - I Semester

Course Code: GR15D5179 L/T/P/C: 3/1/0/4

**PREREQUISITES**

- Fundamentals of enterprise resource planning (ERP) systems concepts
- Importance of integrated information systems in an organization.

**COURSE OBJECTIVES:** The objective of the course is to provide the student

- Understanding of the basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems
- Thinking in ERP systems: the principles of ERP systems, their major components, and the relationships among these components
- Capability to adapt in-depth knowledge of major ERP components, including material requirements planning, master production scheduling, and capacity requirements planning
- Understanding knowledge of typical ERP systems, and the advantages and limitations of implementing such systems
- Understanding the business process of an enterprise
- Grasp the activities of ERP project management cycle
- Understanding the emerging trends in ERP developments

**COURSE OUTCOMES:** At the end of the course the student will be able to

- Examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among the components
- Understand production planning in an ERP system, and systematicallydevelop plans for an enterprise
- Use methods to determine the correct purchasing quantity and right time to buy an item, and apply these methods to material management
- Understand the difficulties of a manufacturing execution system, select a suitable performance measure for different objectives, and apply priority rules to shop floor control
- Knowledge of ERP implementation cycle
- Awareness of core and extended modules of ERP
- Apply emerging trends in ERP

**UNIT-I**

**Introduction:** Overview – Benefits of ERP – ERP and Related Technologies – Business Process Reengineering – Data Warehousing – Data Mining – On–line Analytical Processing – Supply Chain Management.

**UNIT-II**

**IMPLEMENTATION:** Implementation Life Cycle – Implementation Methodology – Hidden Costs – Organizing Implementation – Vendors, Consultants and Users – Contracts – Project Management and Monitoring.

**UNIT- III**

**BUSINESS MODULES:** Business Modules in an ERP Package – Finance – Manufacturing – Human Resource –Plant Maintenance – Materials Management – Quality Management – Sales and Distribution.

**UNIT- IV**

**ERP MARKET:** ERP Market Place – SAP AG – PeopleSoft – Baan Company – JD Edwards World Solutions Company – Oracle Corporation – QAD – System Software Associates.

**UNIT- V**

**ERP-Present and future :**Turbo Charge the ERP System – EIA – ERP and E–Commerce – ERP and Internet – Future Directions in ERP.

**TEXT BOOKS**

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill, 1999.
2. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, “Concepts in Enterprise Resource Planning” , Thomson Learning, 2001.
3. Vinod Kumar Garg and N.K .Venkata Krishnan, “Enterprise Resource Planning – concepts and Planning”, Prentice Hall, 1998.
4. Jose Antonio Fernandz, “ The SAP R /3 Hand book”, Tata McGraw Hill

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## MODERN CONTROL THEORY
## (Open Elective-I)

M.Tech (EEE) I Year - I Semester

Course Code: GR15D5180 L/T/P/C: 3/1/0/4

**PREREQUISITE:** Control Systems, Mathematics.

### COURSE OBJECTIVES

- To familiarize students with the modelling of systems
- To familiarize the students with the state space analysis of dynamic systems and observe their controllability and Observability.
- To make students understand the concepts of describing function analysis of nonlinear systems and analyze the stability of the systems.
- To analyze the stability of the nonlinear systems.

### COURSE OUTCOMES

- Ability to obtain the mathematical model of any system.
- Ability to obtain the state model for dynamic systems.
- Ability to analyze the controllability and Observability for various types of control systems.
- Ability to understand the various types of nonlinearity.
- Ability to analyze the stability of the nonlinear systems.
- Ability to synthesize the nonlinear systems.

### UNIT-I

**MATHEMATICAL PRELIMINARIES:** Fields, Vectors, Vector Spaces — Linear combinations and Bases — Linear Transformations and Matrices — Scalar Product and Norms ,Eigenvalues, Eigen Vectors and a Canonical form representation of linear operators, The concept of state — State Equations for Dynamic systems, Time invariance and Linearity Non uniqueness of state model — State diagrams for Continuous-Time State models.

### UNIT-II

**STATE VARIABLE ANALYSIS:** linear Continuous time models for Physical systems-- Existence and Uniqueness of Solutions to Continuous- time State Equations — Solutions of Linear Time Invariant Continuous-Time State Equations—State transition matrix and it's properties.

**CONTROLLABILITY AND OBSERVABILITY-**General concept of controllability— General concept of Observability—Controllability tests for Continuous-Time Invariant Systems ---
Observability tests for Continuous-Time Invariant Systems— Controllability and Observability of State Model in Jordan Canonical form— Controllability and Observability Canonical forms of State model.

**UNIT- III**

**NON LINEAR SYSTEMS -I**

Introduction to Non Linear Systems - Types of Non-Linearities-Saturation-Dead-Zone - Backlash Jump Phenomenon etc;— Singular Points-Introduction to Linearization of nonlinear systems, Properties of Non Linear systems-Describing function-describing function analysis of nonlinear systems-Stability analysis of Non-Linear systems through describing functions.

**UNIT-IV**

**NON LINEAR SYSTEMS-II**

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase- plane analysis of nonlinear control systems.

**UNIT-V**

**STABILITY ANALYSIS**

Stability in the sense of Lyapunov, Lyapunovs stability and Lyapunov's instability theorems - StabilityAnalysis of the Linear continuous time invariant systems by Lyapunov second method — Generation of Lyapunov functions Variable gradient method — Krasooviski's method.

**TEACHING METHODOLOGIES**

1. White board
2. PPTs
3. Seminars

**EXT BOOKS**

1. Modern Control System Theory by M.Gopal — New Age International -1999
2. Modern Control Fngineering by Ogata:K — Prentice Hall – 1997

**REFERENCE BOOK**

1. Control Systems Engineering, N. S. Nise: 4th Ed., Wiley, 2004.Engineering, 4th Ed., Wiley, 2004.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## COMPUTER–ORIENTED NUMERICAL METHODS IN ENGINEERING
## (Open Elective-I)

M.Tech (Civil) I Year - I Semester

Course Code: GR15D5181 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To develop the skill of solving linear algebraic systems by direct and iteration methods.
- To illustrate advanced matrix techniques in the determination of Eigen values and Eigen vectors of square matrix.
- To analyze the performance of various interpolation technique and perform error analysis.
- To compare various numerical differentiation and integration techniques. •
- To explain the various techniques to study Initial and Boundary value problems in ODE.
- To solve a range of problems on applicable software.

**COURSE OUT COMES:** At the end of the course the student will be able to

- Solve linear algebraic system by direct and iteration methods.
- Apply the knowledge of Eigen values and Eigen vectors to some contents in engineering.
- Develop the skill of working with symmetric matrices in the study of Engineering problems.
- Apply the knowledge of interpolation and extrapolation of uniform and non uniform data to certain contents of Civil Engineering.
- Apply the knowledge of numerical differentiation and integration to some contents of Civil Engineering
- Learn grid based methods to solve Initial and Boundary value problems that arise in engineering problems.
- Develop the skill of solving computational problems using software.

### 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.*Demonstration of solutions using open source software in Numerical Methods.

### UNIT-II

**Interpolation:** Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.*Demonstration of solutions using open source software in Numerical methods.

**UNIT - III**

**Finite Difference and their Applications:** Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae 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 Partial differential equations. *Demonstration of solutions using open source software in Numerical Methods.

**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.*Demonstration of solutions using open source software in Numerical Methods.

**UNIT-V**

**Ordinary Differential Equation:** Euler's method – Backward Euler method – Mid point method – single step method-Taylor's series method- R-K Methods-Boundary value problems-Boundary value problems by finite difference method- case studies. *Demonstration of solutions using open source software in Numerical Methods.

***NOTE:** Demonstration of solutions using open source software in Numerical Methods only for the knowledge of students to apply in their Project Works. Not for examination.

**TEXT BOOKS**

1. M.K.Jain-S.R.K.Iyengar, R.K.Jain Numerical methods for scientific and engineering computations, Willey Eastern Limited, 1987
2. S.S.Sastry, Numerical methods.
3. Curtis I.Gerala, Applied numerical analysis, Addisson Wasley published campus.

**REFERENCES BOOKS**

1. C.Chopra, Raymond P.Canal, Numerical methods for Engineers Stevan, Mc. Graw Hill book Company, 4th edition, 2002.
2. C.Xavier, C Language and Numerical methods, New age international publisher, 2003.
3. Dr. M.Shanta Kumar, Computer based numerical analysis, Khanna Book publishers, New Delhi.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED COMPUTER ARCHITECTURE
## (Open Elective-I)

M.Tech (ECE) I Year - I Semester

Course Code: GR15D5182 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To learn how to build the best processor/computing system understanding the underlying tradeoffs and ramifications.
- To identify and analyze the attributes of computer architecture design with recent trend technology.
- To identify the techniques to improve the speed and performance of computers – Parallelism in Instruction level – Hardware approaches - pipelining,dynamic scheduling, superscalar processors, and multiple issue of instructions.
- To implement the design aspects and categorize various issues , causes and hazards due to parallelisms.
- To examine and compare the performance with benchmark standards.
- To understand the framework for evaluating design decisions in terms of application requirements and performance measurements.
- To learn the design and analysis of complex and high performance multiprocessors and supporting subsystems from the quantitative aspect.

**COURSE OUTCOMES:** After going through this course the student will be able to

- An ability to discuss the organisation of computer-based systems and how a range of design choices are influenced by applications.
- An ability to understand the components and operation of a memory hierarchy and the range of performance issues influencing its design.
- An ability to interpret the organisation and operation of current generation parallel computer systems, including multiprocessor and multicore systems.
- An ability to understand the various techniques to enhance a processors ability to exploit instruction-level parallelism (ILP), and its challenges.
- An ability to know the classes of computers, and new trends and developments in computer architecture.
- An ability to develop the applications for high performance computing systems.
- An ability to undertake performance comparisions of modern and high performance computers.

### UNIT -I

**Fundamentals of Computer Design:** Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, measuring and reporting performance, Quantitative principles of computer design, Amdahl's law.

Instruction set principles and examples- Introduction, classifying instruction set- memory addressing type and size of operands, Operations in the instruction set.

**UNIT-II**

**Pipelines:** Introduction, basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties.

**Memory Hierarchy Design:** Introduction, review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

**UNIT-III**

**Instruction Level Parallelism (ILP) - The Hardware Approach:** Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, High performance instruction delivery- Hardware based speculation.

**ILP Software Approach:**

Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues - Hardware verses Software.

**UNIT-IV**

**Multi Processors and Thread Level Parallelism:** Multi Processors and Thread level Parallelism-Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – Memory architecture, Synchronization.

**UNIT-V**

**Inter Connection and Networks:** Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters.
Intel Architecture: Intel IA-64 ILP in embedded and mobile markets Fallacies and pit falls.

**TEXT BOOKS**

1. John L. Hennessy, David A. Patterson - Computer Architecture: A Quantitative Approach, 3rd Edition, an Imprint of Elsevier.

**REFERENCE BOOKS**

1. John P. Shen and Miikko H. Lipasti -, Modern Processor Design : Fundamentals of Super Scalar Processors
2. Computer Architecture and Parallel Processing - Kai Hwang, Faye A.Brigs., MC Graw Hill.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## OPERATIONS RESEARCH
## (Open Elective-I)

Mtech(ME) I Year - I Semester

Course Code: GR15D5183 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** The Objective of this course is to provide

- Analysis of quantitative methods and techniques for effective Decision–making.
- Constructing models that are used in solving business decision problems.
- Introduce the students to the use of basic methodology for the solution of linear programs and integer programs.
- Introduce the students to methods for solving large-scale transportation and assignment problems.
- Illustrate how sequencing is carried out in assigning jobs to machines
- Understand the concept of Inventory and apply different models in optimizing the same.
- Apply PERT/CPM: [Project scheduling and allocation of resources] to schedule and control construction of dams, bridges, roads etc. in an optimal way.

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

- Apply various linear programming techniques for optimal allocation of limited resources such as machine, materials and money
- Solve transportation problems to minimize cost and understand the principles of assignment of jobs and recruitment polices.
- Solve game theory problems.
- Solve problems of inventory and develop proper inventory policies.
- Apply PERT/CPM: [Project scheduling and allocation of resources] to schedule and control construction of dams, bridges, roads etc in a optimal way.
- Solve sequencing problems.
- Develop optimum replacement policy

**UNIT-I**

**Introduction:** Definition and scope of operations research(OR),ORmodel, solving the O**R** model, art of modeling, phases of OR study.

**Linear Programming:**

Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.

**UNIT-II**

**Transportation Problems:** Types of transportation problems, mathematical models, transportation algorithms

**Assignment:** Allocation and assignment problems and models, processing of job through machines.

**UNIT-III**

**Network Techniques:** Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem.
Project Management: Phases of project management, guidelines for network construction, CPM and PERT.

**UNIT-IV**

**Theory of Games:** Rectangular games, Min-max theorem, graphical solution of 2xnormx2 games, game with mixed strategies, reduction to linear programming model.
Quality Systems: Elements of Queuing model, generalized Poisson queuing model.

**UNIT-V**

**Inventory Control:** Models of inventory, operation of inventory system, quantity discount.
Replacement models: Equipments that deteriorate with time, equipments that fail with time.

**TEXT/ REFERENCE BOOKS:**

1. Wayne L. Winston,"OperationsResearch", Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research - An Introduction", Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research", PHI Learning, 2008.
4. V. K. Khanna, "Total Quality Management", New Age International, 2008.

**TEACHING METHODOLOGY**

1. Lecture is delivered on blackboard, preparing OHP sheets and by preparing Power point presentations.
2. Seminars are conducted on new technologies related to subject.
3. Assignments are given.
4. Group discussions are conducted on familiar topics related to subject.
5. Industrial visits for practical exposure to understand and explore things.

# II- SEMESTER

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING

M.Tech (STE) I Year - II Semester
Course Code: GR15D5162 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To equipstudents with the finite element analysis fundamentals like discretization and principle of elasticity.
- To enable the students to formulate the stiffness elements for one and two dimensional elements.
- To introduce of Iso-parametric, Axisymmetric and 3D element formulation.
- Analyse the plates, shells using finite element analysis.
- To enable the students for non-linear analysis using FEM and software used in FEM.

**CORSE OUTCOMES:** By the end of this course, Student should be able to

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Define basic aspects of finite element technology including domain discretization, polynomial interpolation , application of boundary conditions, assembly of global arrays and solution of resulting algebraic systems.
- Compare the solutions obtained from finite element analysis.
- Formulate finite element analysis equation.
- Evaluate finite element software to solve energy problems in solid mechanics, fluid mechanics and heat transfer.
- Solve element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

### UNIT - I

**Introduction:** Concepts of FEM - steps involved - merits and demerits - energy principles – discritization - 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 for 1-D 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 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. Application of FEM using open source softwares*

*Note:Demonstration of open source softwares only for the purpose of knowledge for project work, not for examination

**TEXT BOOKS**

1. GS Krishna Murthy, Finite element analysis, theory and programming, 3rd Edition, 1994.
2. Tirupathi Chandra Patila and Belugunudu, Introduction to Finite element Method.

**REFERENCES**

1. Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons, Concepts and Applications of Finite Element Analysis, International Edition, Oct 17, 2001.
2. OC Zienkiewicz, Finite element Methods, 1987.
3. JN Reddy, Introduction to Finite element Methods, 1993.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## STRUCTURAL DYNAMICS

M.Tech (STE) I Year - II Semester
Course Code: GR15D5163 L/T/P/C: 3/1/0/4

### PREREQUISITES

- Exposure to linear algebra and matrices.
- Knowledge of Matrix methods in structural analysis.

**COURSE OBJECTIVES:** The objective of this course is

- Ensure of understanding the basic concepts of vibratory systems.
- To introduce to structural dynamics and provide comprehensive knowledge about the dynamics of SDOF systems and their responses to various types of dynamic loadings.
- To acquire knowledge of Multiple DOF systems and their dynamic response.
- To educate with numerical methods for practical vibration analysis and dynamic responses of continuous systems.
- To familiarize with methods of earthquake analysis and its Indian standard codes.

**COURSE OUTCOMES:** On successful completion of this course, it is expected that students should be able to

- Illustrate the fundamental concepts of free /forced and damped/un-damped vibratory systems.
- Distinguish single DOF systems and their responses to various types of dynamic loadings.
- Analyse Multiple DOF systems and their dynamic responses in terms of modes and mode shapes
- Analyse the dynamics response in terms of geometric and normal coordinates.
- Perform practical vibration analysis using numerical methods
- Analyze the flexural behavior of continuous systems.
- Develop fundamentals in earthquake analysis.

### 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 -Dynamic magnification factor – Phase angle – Bandwidth

**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 - I. S. Code methods of analysis for obtaining response of multi storeyed buildings.

**TEXT BOOKS**

1. Clough &Penzien, Dynamics of Structures, McGraw Hill, New York, 1st January, 1975.
2. Mario Paz, Structural Dynamics, C.B.S Publishers, New Delhi, 2nd Edition, 2004.

**REFERENCE BOOKS**

1. Anil K. Chopra, Dynamics of Structures, Pearson Education (Singapore), Delhi, 4th Edition, 2011.
2. I.S: 1893 - 1984, "Code of practice for Earthquake resistant design of Structures" and latest I.S: 1893 - 2002 (version) Part-1

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED STEEL DESIGN

M.Tech (STE) I Year - II Semester
Course Code: GR15D5165 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To learn the behaviour and design of structural steel components
- Carry out qualitative evaluations as well as detailed analysis of steel structures.
- Carry out analysis and design of member joints with riveted bolted and welded connections.
- To study various eccentric and momentconnections (welded and riveted), seated connections (Unstiffened and Stiffened connections) and to design them.
- To study the components of steel truss girder, loads on trusses, analysis and design of purlins and truss members
- To study and design the components of industrial buildings such as purlins, girts, rafter, tie runner, side runner, Eaves strut, truss members.
- To design and analyse steel bunkers and silos.

**COURSE OUTCOMES:** On successful completion of this course, it is expected that students should be able to

- Identify and compute the design loads on a typical steel building.
- Identify the different failure modes of bolted and welded connections, and determine their design strengths.
- Design bolted and welded connections for tension and compression members and beams.
- Analyze and design of beam-columns connection
- Calculate forces on the various members of the truss and design them analyze the beha viour of bolted connections and design them design welded connections for both axial and eccentric forces
- Analyse various industrial steel buildings and components such as purlins, girts.
- Design of steel bunkers and silos.

### 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 Bracketed Connections. Bolted Moment Connections – Welded Framed Connections – Welded bracketed Connections,Welded Seat Connection - 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 – Janseen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom –Design of Bins.

**TEXT BOOKS:**

1. S.K. Duggal, Limit State Design of Steel Structures, Mc Graw Hill Education Private Ltd. New Delhi, 2nd Edition, 2010.
2. N. Subramanian, Design of steel structures.

**REFERENCE BOOKS**

1. P. Dayaratnam, Design of Steel Structures, Publisher: S. Chand, Edition 2011 – 12.
2. Dr. Ramachandra &Vivendra, Design Steel Structures Volume – II, GehlotScientific Publishes Journals Department, 1st Dec, 2008, 9th Edition.
3. Galyord& Gaylord, Design of Steel Structures, Publisher; Tata Mc Graw Hill, Education. Edition ,2012.
4. Indian Standard Code – IS – 800-2007.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED PRESTRESSED CONCRETE
## ELECTIVE –III

M.Tech (STE) I Year - II Semester

Course Code: GR15D5166 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** Student will be able to

- Develop an understanding of the necessity of prestressed concrete structures.
- Develop an understanding of various techniques of prestressing.
- Develop an understanding of the design of prestressed concrete members for ultimate, limit state and limit state of serviceability.
- Develop an understanding of the design of continuous beams and simple portal frames

**COURSE OUTCOMES:** On successful completion of this course, it is expected that students should be able to

- Acquire the knowledge of evolution of process of prestressing.
- Acquire the knowledge of various prestressing techniques.
- Analyse and design of prestressed concrete beams, and slabs.
- Understand the terminology related to pre-stressing and pre-stressing systems
- Analyse and Design of pre-tensioned as well as post-tensioned concrete beams and slabs using working stress as well as limit state methods
- Analyse and design the anchorage systems for pre-stressing at the construction site to design various pre-stressed structures and retaining elements.
- analysis of continuous beams and simple portal frames (single bay and single story)

**UNIT - I**

**General Principles of Prestressed Concrete (PSC):** Pre–tensioning and post – tensioning – Prestressing by straight, concentric, eccentric, bent and parabolic tendons – Different methods and systems of pre - stressing like Hoyer system, Freyssinet system, Magnel Blaton system – Lee-Mc call system

**Losses of Prestress:** Loss of prestress in pretensioned and posttensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss – Analysis of sections for flexure.

**UNIT - II**

**Design of Section for Flexure:** Allowable stresses – Elastic design of simple beams having rectangular and I-section for flexure – kern lines – cable profile and cable layout. Design of Sections for Shear: Shear and Principal stresses – Improving shear resistance by different prestressing techniques – horizontal and vertical pre-stressing – Analysis of rectangular and I-beam – design of shear reinforcement – Indian code provisions.

**UNIT - III**

**Deflections of Prestressed Concrete Beams:** Short term deflections of uncracked members– Prediction of long-time deflections – load – deflection curve for a PSC beam – IS code requirements for max deflections.

**UNIT - IV**

**Transfer of Pre-stress in Pre-tensioned Members:** Transmission of pre-stressing force by bond –Transmission length – Flexural bond stresses – IS code provisions –Anchoragezone stresses in post tensioned members – stressdistribution in Endblock Analysis by approximate Guyon and Magnel methods – Anchorage zone reinforcement

**UNIT - V**

**Statically Indeterminate Structures:** Advantages & disadvantages of continuous PSC beams– Primary and secondary moments – P and C lines – Linear transformation concordant and non-concordant cable profiles – Analysis of continuous beams and simple portal frames (single bay and single story)

**TEXT BOOKS**

1. N. Krishna Raju, Prestressed concrete, Tata Mc Graw Hill Book – Co., New Delhi, 5th Edition, 2012.
2. S. Ramamrutham, Prestressed concrete, Dhanpat Rai & Sons, Delhi, 2nd Edition, 1983.

**REFERENCE BOOKS**

1. T.Y. Lin and Burn, John Wiley, Design of prestress concrete structures, New York, 3rd Edition, 1981.
2. Dayaratnam, PrestressedConcrete.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## COMPUTER AIDED DESIGN IN STRUCTURAL ENGINEERING

## ELECTIVE -III

M.Tech (STE) I Year - II Semester
Course Code: GR15D5168 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** Student will be able to

- Understand computer as a design medium.
- Write different programs using "C" language.
- Write various program using "C" graphics.
- Understand database management systems.
- Know about artificial intelligence.

**COURSE OUTCOMES:** On successful completion of this course, it is expected that students should be able to

- understand computer as a design medium
- Write programs using C language
- Write programs using C graphics and generate display of geometries
- Analyse problems of structural analysis using C and computer graphics
- Apply computer graphics to design various structural elements
- Demonstrate the operations of Data Base Management System
- Represent development in Knowledge based expert system

### UNIT - I

Introduction to computer aided design-An over view-computer as a design medium hardware components of a computer -programming languages.
C - Programming language-Introduction-An over view of programming in C-variables and data types- Declaration of variables-Initialization of variables-operators-arithmetic operators-precedence and associability-Input and output-Character I/O-Formatted output. Print f ()-Formatted input scan f ()- Examples.

### UNIT - II

C Programming Language-Control structures-If statement-Switch statement-loops-nested loops-while and for , Do-While-continue statement-Go to statement-Examples.
C Programming Language-Arrays-One dimensional Arrays-Two Dimensional Arrays-pointer operators- pointer arithmetic-pointers and arrays-Matrix manipulations using arrays and pointers-pointers to functions-data files-basic operations-reading and writing and file accessing files-examples.

**UNIT - III**

Computer Graphics-introduction-applications graphic devices-display devices-output and input devices- two dimensional geometric transformations-homogeneous co-ordinates-world co-ordinates-device co- ordinates-window to view port-transformations-clipping operations.

**UNIT - IV**

Data base management system-introduction-data base systems-hardware-software-users-operational data independence-architecture of data base system-distributed databases.

**UNIT - V**

Knowledge based expert system-introduction-artificial intelligence-components of an expert system- stages in expert system development-knowledge representation-inference mechanisms-applications.

**TEXT BOOK**

1. C.S.Krishnamoorthy and S.Rajeev, Computer Aided Design.

**REFERENCE BOOKS**

1. S.Rajasekharan, Computational Structures.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED DESIGN OF STRUCTURES
## ELECTIVE-III

M.Tech (STE) I Year - II Semester

Course Code: GR15D5167 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** On completion of this Subject/Course, following objectives shall get accomplished

- To provide students about the design of structures with an acceptable probability and performing satisfactorily during their intended life
- To train the students about the design of structure which sustain all loads and deform within the limits.
- To make understand the students about the design of structure which is durable.
- To make understand the students about the design of structure which adequately resists the affects of misuse and fire.
- To train the students about the detailing of structures.
- To train the students about teaching of structural design to UG & PG students.
- To motivate the students about the Research Development activities of RCC which results in durable and economical structures.

**COURSE OUTCOMES:** On completion of this Subject/Course the student shall be able to

- Design the reinforced concrete structures with an acceptable probability and performing satisfactorily during their intended life by using Limit state method of design & IS 456:2000.
- Design the reinforced concrete structures which sustain all loads and deform within the limits.
- Design the reinforced concrete structures which are durable by properly detailing the reinforcement.
- Design the reinforced concrete GL & OH Water Tanks & Staging
- Design the reinforced concrete RAFT & PILE FOUNDATIONS for the given loads and moments
- Design the reinforced concrete Retaining walls & Plain concrete walls for the given loads.
- Design the reinforced concrete Deck Slab Bridge for IRC loadings for the given loads and moments

**UNIT-I**

**Design & Detailing of Water Tanks:** Design Principles; permissible Stresses in Concrete & Steel; provisions of IS 3370. Design of circular tank with flat base slab supported on Ground; Design & Detailing of an Intze type tank and Design of its staging.

**UNIT-II**

**Design of Plain Concrete Walls & R.C Staircases:** Plain and RC concrete walls, braced and

unbraced walls, slenderness ratio, reinforcement requirements, Design of plain concrete wall. Types of Stairs, loads, IS provisions for staircases spanning transversely& longitudinally Design & Detailing of Normal Stair Case, Rise & Tread Type Stairs and Cantilever Stairs.

**UNIT-III**

**Design of Foundations:** Types, design considerations, design of Raft/Mat foundation as per IS code. Design of Deep Foundations- Design considerations for piles and pile groups. Codal provisions for the design of pile caps, Design & Detailing of Piles & Rectangular pile caps for a group of piles.

**UNIT-IV**

**Design of Retaining Walls:** Types of retaining walls and their behavior, Active & passive earth pressures and stability requirements as per IS 456. Design & Detailing of of a cantilever Retaining wall and a Counterfort Retaining wall

**UNIT-V**

**Bridge Engineering – Design of Solid Deck Slab Bridge:** Introduction, Types of Bridges, Economic Span Length, IRC Loadings & Code Provisions, Effective Width Method of Analysis, Design and Detailing of Solid Deck Slab Bridge for IRC Loading and Design of Kerb.

**TEXT BOOKS**

1. Reinforced Concrete Design by S.Unnikrishna Pillai and Devdas Menon, Tata McGraw-Hill, Education Private Limited, New Delhi, Third Edition-2009.
2. Limit State theory & Design of reinforced concrete by V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune, Fourth Edition-2003.
3. Bridge Design by N Krishna Raju.

**REFERENCE BOOKS**

1. Relevant IS Codes & SPs.
2. Advanced reinforced concrete design by P C Varghese.
3. Advanced concrete design by N Krishna Raju.
4. Concrete Bridge Design and Practice by V K Raina.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## PRINCIPLES OF BRIDGE ENGINEERING
## ELECTIVE-IV

M.Tech (STE) I Year - II Semester

Course Code: GR15D5169 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To introduce students to the design and analysis of types of loadings.
- To introduce basic principles, types of loadings & design and analysis of different theories.
- To provide basic expo sure about design requirements of road bridges.
- Design the bearings, Joints, pipes & abutments. Select the appropriate method.

**COURSE OUT COMES:** On completion of this Subject/Course the student shall be able to

- Apply knowledge of mathematics Science & Engineering.
- Understand the Structural behaviour of diff longitudinal and transverse bridge types.
- Understand the Stresses and expansion bearings.
- Design the reinforcement in prestressed Concrete members and propped Composite Sections.
- Design the bearings, joints & piers & abutments.
- Select the appropriate design method.
- Identify, formulate & Solve different load conditions.

### 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- 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, via duct theory.

### UNIT- III

**Girder Bridges:** Introduction-Method of Analysis and Design-Courbon's Theory, Grillage analogy, Gifford Mason method.

### UNIT - IV

**Pre-Stressed Concrete Bridges:** Basic principles-General Design requirements-Mild steel reinforcement in pre-stressed 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 Pre-stressing-Shrinking stresses-General Design requirements for Road Bridges.

## UNIT - V

**Analysis of Bridge Decks:** Harmonic analysis and folded plate theory-Grillage analogy- Finite strip method and FEM. Sub-structure of bridges: Substructure- Beds block-Piers- Pier Dimensions-Design loads for piers- Abutments- Design loads for Abutments.

## TEXT BOOKS

1. N. Krishna Raju, Bridge Design.
2. M.G.Aswani, V.N.Vazirani and M.M.Ratwani, Design of Concrete Bridges.

## REFERENCE BOOKS

1. E.C.Hambly, Bridge Deck Behaviour.
2. V.K.Raina, Concrete Bridge Design and Practice.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ANALYSIS AND DESIGN OF SHELLS AND FOLDED PLATES

## ELECTIVE-IV

M.Tech (STE) I Year - II Semester
Course Code: GR15D5164 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** Students will be able to

- Understand different types of shells.
- Know different theories for analysis of shells.
- Know procedure to analyze the structure.
- Differentiate between different theories of analysis.
- Know design procedure for different shells.
- Know importance of folded plates and their analysis.

**COURSE OUTCOMES:** On successful completion of this course, it is expected that students should be able to

- Use appropriate theory to analyze the shell structure.
- Differentiate a shell structure based on its properties
- Design shell structures of singly curved.
- Understand the structural importance of shells.
- Design shell structures of doubly curved.
- Understand the structural importance of folded plates.
- Analyze Folded plates using Whitney's method/Simpsons method.

### UNIT - I

**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 - II

Derivation of the governing DKJ equation for bending theory. Schorer's theory, Application to the analysis and design of short and long shells.
Beam theory of cylindrical shells: Beam and arch action, Analysis using beam theory.

### UNIT - III

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

**UNIT - IV**

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

**UNIT - V**

**Folded plates** – Introduction – Types of folded plates – structural behaviour of folded plates – advantages – Assumptions Whitney method of analysis – Edge shear equation - Analysis of folded plates of Whitney's method.

**Simpsons method of Analysis of folded plates** – moment and stress distribution – no rotation and rotation solutions – continuous folded plates – pre stressed continuous folded plates.

**TEXT BOOKS**

1. G.S.Ramaswami, Analysis and design of concrete shell roofs, 3rd Edition, 1994.
2. Chaterjee, Design of concrete shell roofs, 3rd Edition, 1990.

**REFERENCE BOOKS**

1. Billington, Design of concrete shell roofs, 3rd Edition, 1990.
2. N.K.Bairagi, Shell Analysis.
3. Dr.N.Krishna Raju, Advanced R.C Design.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## EARTHQUAKE RESISTANT DESIGN OF BUILDINGS

## ELECTIVE -IV

M.Tech (STE) I Year - II Semester
Course Code: GR15D5170 L/T/P/C: 3/1/0/4

### COURSE OBJECTIVES

- To make the students to understand the concepts of Engineering seismology.
- To analyse building for earthquake forces and introduce design concepts .
- To explain the design guidelines for earthquake resistant masonry and RCC members of building.
- To know the failure mechanism of non structural members and its effect on structural system.
- To acquire the knowledge on detailing of reinforcement in earthquake resistant structures.

**COURSE OUTCOMES:** On completion of this Course, the student shall be able to

- Identify the ground motion and its relationship of seismic design of structures.
- Calculate earthquake induced lateral force on the structure by using different methods.
- Predict damage to un-reinforced masonry buildings and identify the vulnerable features.
- Apply the basic principles of conceptual design for earthquake resistant RC Buildings and carry out the detailed design of earthquake resistant RC Buildings.
- Analyse the non structural elements so as to prevent the structural damage.
- Assess existing building structures and provide plans for their effective retrofitting
- Acquire the knowledge on detailing of reinforcement and ductility considerations in earthquake resistant structures.

### 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.

### UNIT - II

**Conceptual Design:** Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations-basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-

equivalent lateral force method-dynamic analysis-response spectrum method-Time history method.

**UNIT - III**

**Reinforced Concrete Buildings:** Principles of earthquake resistant deign of RC members- Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods- IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities-Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces-Equivalent lateral force procedure- Lateral distribution of base shear. Masonry Buildings: Introduction- Elastic properties of masonry assemblage- Categories of masonry buildings-Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls- Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses- Seismic design requirements- Lateral load analysis of masonry buildings.

UNIT - IV

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls- sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non- structures- Effects of non-structural elements on structural system- Analysis of non-structural elements- Prevention of non-structural damage- Isolation of non-structures.

**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. Behaviour of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes. Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns- Case studies.

**TEXT BOOKS**

1. S. K. Duggal, Earthquake Resistant Design of structures, Oxford University Press.
2. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of structures, Prentice Hall of India Pvt. Ltd.,
3. T. Paulay and M.J.N. Priestly, John Wiley & Sons, Seismic Design of Reinforced Concrete and Masonry Building.

**REFERENCE BOOKS**

1. AnandS.Arya, Nemchand& Bros, Masory and Timber structures including earthquake Resistant Design.
2. MihaTomazevic, Earthquake –Resistant Design of Masonry Building, Imperial college Press.
3. C.V.R. Murty, Earthquake Tips – Learning Earthquake Design and Construction.

**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.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## ADVANCED CAD LAB

M.Tech (STE) I Year - II Semester

Course Code: GR15D5172 L/T/P/C: 0/0/2/2

### COURSE OBJECTIVE

- Compare mathematical modelling and computational methods in the areas of non-linear, static and dynamic analysis of structures.
- To learn the programming of numerical methods.
- To use the computer to apply numerical techniques.
- To learn the fundamentals of Computer Aided Drafting.
- To learn the handling of spreadsheets.
- To learn and acquire computer programming for civil engineering application.
- To know about some popular programming languages and how to choose programming language for solving a problem.

**COURSE OUTCOMES: :** On completion of this Course, the student shall be able to

- Use Computer Aided Structural Analysis using popular structural analysis and design software
- Apply recent advances in the development and use of computer methods for the solution of scientific and engineering problems related to structures.
- Develop programs for numerical methods.
- Solve numerical techniques in computer.
- Apply Spreadsheet calculations for design of structural elements.
- Write, compile and debug programs in C language.
- Solve structural design problem using software.

1. Program using arrays and functions for matrix manipulation.
2. Programs to draw bending moment and shear force diagrams. Using graphic in C
3. Program for design of slabs using Excel
4. Program for design of beams using Excel
5. Program for design of column using excel
6. Program for design of footing using excel
7. Analysis of truss using STAAD Pro.
8. Analysis of multistoried space frame, using STAAD Pro and E-tab.
9. Analysis of Bridge deck slab using STAAD PRO
10. Analysis and Design of Elevated tanks and Silos by using SAP.
11. Demonstration of Finite element simulation in Structural engineering using open source software in Numerical computation:SciLab

# OPEN ELECTIVE - II

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## HUMAN COMPUTER INTERACTION
## (Open Elective-II)

M.Tech (CSE) I Year - II Semester

Course Code: GR15D5184 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** Students undergoing the course are expected to:

- Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
- Recognize how a computer system may be modified to include human diversity.
- Select an effective style for a specific application.
- Design mock ups and carry out user and expert evaluation of interfaces.
- Carry out the steps of experimental design, usability and experimental testing, and
- Evaluation of human computer interaction systems.
- Use the information sources available, and be aware of the methodologies and technologies supporting advances in HCI.

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

- Describe what interaction design is and how it relates to human computer interaction and other fields.
- Describe the social mechanisms that are used by people to communicate and collaborate.
- Describe how technologies can be designed to change people's attitudes and behavior.
- Discuss how to plan and run a successful data gathering program.
- Discuss the difference between qualitative and quantitative data and analysis.
- Discuss the conceptual, practical, and ethical issues involved in evaluation.
- Describe how to perform two types of predictive techniques, GOMS and Fitts Law, and when to use them.

**UNIT-I**

**Introduction:** Importance of user Interface –definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface –popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics-Principles of user interface.

**UNIT-II**

**Design process:** Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, Understanding business junctions.

**UNIT-III**

**Screen Designing:**Design goals –Screen planning and purpose, organizing screen elements, ordering of screen data and content –screen navigation and flow –Visually pleasing composition

–amount of information –focus and emphasis –presentation information simply and meaningfully –information retrieval on web –statistical graphics –Technological consideration in interface design.

**UNIT-IV**

**Develop System Menus and Navigation Schemes**-Select the proper kinds of Windows, -Select the proper Device based Controls, Choose the proper screen based controls.

**UNIT-V**

**Mobile Ecosystem:** Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

**Interaction Devices** – Keyboard and Function Keys – Pointing Devices – Speech Recognition Digitization and Generation – Image and Video Display – Drivers.

**TEXT BOOKS**

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dreamtech.
2. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia
3. Brian Fling, “Mobile Design and Development”, First Edition, Reilly Media Inc., 2009

**REFERENCE BOOKS**

1. Human – Computer Interaction. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, Pearson Education
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen, Pearson Education.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## BIG DATA ANALYTICS
## (Open Elective-II)

M.Tech (IT) I Year - II Semester

Course Code: GR15D5185 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** The objective of the course is to provide the student:

- Understanding about big data for business intelligence
- Learning business case studies for big data analytics
- Learning about the cloud and big data
- Knowledge about risk management involved in big data
- Understandingnosql big data management
- Understanding about map reduce work flows.
- Capability to Perform map-reduce analytics using Hadoop and related tools

**COURSE OUTCOMES:** At the end of the course the student will be able to:

- Understand the importance of big data
- Understand challenges with big data
- Knowledge about the technological developments in big data environment
- Understanding about map reduce work flows
- Knowledge about nosql data environment.
- Analysis with Hadoop and related tools
- Capability of understanding the usage of big data in context to cloud and other technologies.

**UNIT-I**

**INTRODUCTION TO BIG DATA** What is big data, why big data, convergence of key trends , unstructured data ,industry examples of big data ,web analytics, big data and marketing, fraud and big data ,risk and big data ,credit risk management, big data in medicine, introduction to Hadoop open source technologies , cloud and big data

**UNIT-II**

**UNDERSTANDING BIG DATA** Types of digital data, characteristics of data, challenges with big data, definition of big data, big data analytics,data science, technologies in big data environments, CAP theorem.

**UNIT-III**

**NOSQL DATA MANAGEMENT** Introduction to NoSQL, aggregate data models, aggregates, key-value and document data Models, relationships, graph databases , schemaless databases ,materialized views, distribution models, sharding ,master-slave replication, peer-peer replication, sharing and replication

**UNIT-IV**

**BASICS OF HADOOP** Data format ,features of Hadoop, analyzing data with Hadoop , design of Hadoop distributed file system (HDFS) ,HDFS concepts, scaling out ,Hadoop streaming , Hadoop pipes, Hadoop related tools

**UNIT- V**

**MAPREDUCE APPLICATIONS** MapReduce workflows, unit tests with MRUnit , test data and local tests, anatomy of MapReduce job run ,classic Map-reduce, YARN ,failures in classic Map-reduce and YARN , job scheduling , shuffle and sort ,task execution, MapReduce types ,input formats, output formats

**TEXT BOOKS**

1. Seema Acharya,S.Chellappan,"Big Data and Analytics",Wiley,2014

**REFERENCE BOOK**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## NEURAL AND FUZZY SYSTEMS
## (Open Elective-II)

M.Tech (EEE) I Year - II Semester

Course Code: GR15D5186 L/T/P/C: 3/1/0/4

**PRE–REQUISITE:** Control Systems, Power Systems, Mathematics, Physics.

**COURSE OBJECTIVES:** The objective of the course is to provide the student

- To introduce the students with the concepts of learning methods.
- To provide students with the artificial neural networks and their architecture.
- To familiarize the students with the various applications of artificial neural networks.
- To introduce the concepts of the fuzzy logic control and their real time applications.

**COURSE OUTCOMES:** At the end of the course the student will be able to

- Define the advances in neural networks
- Evaluate the design and control of fuzzy systems.
- Articulate the applications of fuzzy control block sets.
- Evaluate the design of various models in neural networks
- To analyze the techniques of various types of neural networks
- Evaluate the design and control of associative memories
- Techniques to Design fuzzy logic system

### UNIT-I

**Introduction to Neural Networks:** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

### UNIT-II

**Essentials of Artificial Neural Network**s: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

**Feed Forward Neural Networks**

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

UNIT-III

**Multilayer Feed forward Neural Networks**

Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

**Associative Memories**

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

**UNIT-IV**

**Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART)**

Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition.

**UNIT-V**

**Classical and Fuzzy Sets and Fuzzy Logic System Components**

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

**Applications Neural network applications:** Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

**Fuzzy logic applications:** Fuzzy logic control and Fuzzy classification.

**TEACHING METHODOLOGIES**

1. White board
2. PPTs
3. Seminars

**TEXT BOOK**

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and G.A.VijayalakshmiPai – PHI Publication.

**REFERENCE BOOKS**

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Neural Engineering by C.Eliasmith and CH.Anderson, PHI
3. Neural Networks and Fuzzy Logic System by Bork Kosko, PHI Publications

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## PROJECT MANAGEMENT

M.Tech(Civil) I Year - II Semester
Course Code: GR15D5187 L/T/P/C: 3/1/0/4

**COURSE OBJECTIVES:** On completion of this Subject/Course, following objectives shall get accomplished

- To provide students about the basics of Management in general and Project Management in particular.
- To train the students about the Monitoring of Projects.
- To make understand the students about the Planning of projects.
- To make understand the students about the Scheduling of projects.
- To train the students about the drawing of CPM & PERT Networks.
- To train the students about teaching of Project Management to UG & PG students
- To motivate the students about the Research Development activities of Project Management which results in timely completion of projects without time and cost over runs.

**Course outcomes:** On completion of this Subject/Course the student shall be able to

- Perform the Project Management functions effectively.
- Plan the projects.
- Schedule the various activities of Projects.
- Monitor the actual progress with planned progress.
- Draw the CPM & PERT Networks/
- Handle Resources planning including levelling & smoothing.
- Interpret the Indian Contract Act and understand the litigations involved for better Contract Management.

**UNIT- I**

**PROJECT PLANNING:** Prime Objectives of Project Management, Main Functions of Project Management, Planning, Principles of Planning, Objectives of Planning, Steps involved in Planning, Stages of Planning, Advantages & limitations of Planning, Failures of Projects & Construction Projects.

**UNIT-II**

**PROJECT SCHEDULING:** Scheduling, Project/Construction Schedules, Steps involved in Scheduling, Methods of Scheduling, Bar Charts, Steps involved in Bar Charts, Limitations of Bar Charts, Milestone Charts and Limitations of Milestone Charts.

**UNIT-III**

**PROJECT MONITORING:** Network Techniques, Prime Objectives of Networks, Network Terminology, Types of Networks, CPM & PERT, Differences between CPM & PERT, Rules to draw the Network, Drawing of Networks, Advantages of Network , Critical Path, Float and its Types, Slack and Types of Slack.

**UNIT-IV**

**PROJECT COST CONTROL:** Direct Costs, Indirect Costs, Total Project Cost, Optimisation of Cost and Steps involved, Resources, Resources Smoothing and Resources Levelling, Crashing of Activities, Time and Cost Over runs of Project.

**UNIT-V**

**PROJECT QUALITY & CONTRACTS:**

Quality, Quality Control, Quality Assurance, Project Quality Plans in Construction Projects, Inspection & Test Plans, Method Statements, ISO Certification; Project Contracts, Contract Law, Types of Contracts and Indian Contract Act.

**TEXT BOOKS**

1. Project Planning and Control with PERT & CPM – BC Punmia, KK Khandielwala.
2. Project Scheduling & Monitoring in Practice – S Chowdhury

**REFERENCE BOOKS**

1. Project Management Handbook – Lock, Gower
2. Project Management – NJ Smith- Blackwell Publication.

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## HARDWARE - SOFTWARE CO-DESIGN
## (Open Elective-II)

M.Tech (ECE) I Year - II Semester

Course Code: GR15D5188 L/T/P/C: 3/1/0/4

**Course Objectives**

- Describe an embedded system design flow from specification to physical realization
- Describe structural behavior of systems.
- Master complex systems.
- Devise new theories, techniques, and tools in design, implementation and testing.
- Master contemporary development techniques.

**Course Outcomes:** After going through this course the student will be able to

- Gain knowledge of contemporary issues and algorithms used.
- Know the interfacing components, different verification techniques and tools.
- Demonstrate practical skills in the construction of prototypes.
- Understand the use of modern hardware and software tools for building prototypes of embedded systems.
- Apply embedded software techniques to satisfy functional and response time requirements.
- Apply verification tools.
- Understand design representation for system level synthesis.

**UNIT-I:**

**Co- Design Issues:** Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

**Co- Synthesis Algorithms:**

Hardware software synthesis algorithms: hardware – software partitioning distributed system cosynthesis.

**UNIT –II:**

**Prototyping and Emulation:** Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure

**Target Architectures:** Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

**UNIT-III**

**Compilation Techniques and Tools for Embedded Processor Architectures:** Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

**UNIT-IV**

**Design Specification and Verification:** Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

**UNIT-V**

Languages for System – Level Specification and Design-I: System – level specification, design representation for system level synthesis, system level specification languages,

**Languages for System – Level Specification and Design-II:**

Heterogeneous specifications and multi language co-simulation, the cosyma system and lycos system.

**TEXT BOOKS**

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf –2009, Springer.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers

**REFERENCE BOOKS**

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont - 2010 –Springer

# GOKARAJU RANGARAJU

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

## NON CONVENTIONALENERGYRESOURCES

## (Course Objectives)

M.Tech (ME) I Year - II Semester
Course Code: GR15D5189

**Course Objectives:** The Objective of this course is to provide the student to

- Interduce the need of the non-convectional energy sources.
- Impart the role of non-convectional energy for the environment.
- Identify the energy resources utilization systems.
- Recognise the source and potential of wind energy and understand the classifications of wind mills.
- Summarize the principles of bio-conversion, ocean energy and geo thermal energy.

**Course Outcomes:** At the end of the course the learners will be able to

- Choose the appropriate renewable energy as an alternate for conventional power in any application.
- Analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels.
- Apply the principles of various energy systems in day to day life.
- Analyze the industrial needs and convert theoretical model to practical circuits with wide range of specifications.
- Evaluate the importance of the renewable resources of energy as the fossil fuels are depleting in the world very fast express about clean and green energy for next generation.
- Analyse large scale demand of heat energy for meeting day to day domestic, institutional and industrial requirements can be met by utilizing solar thermal systems, biogas, PV cells, wind energy, Geothermal, MHD etc.
- Design the various techniques and models fabricated in utilizing the above said sources of energy.

### UNIT-I

**Introduction:** Various non-conven tionalenergy resources-Introduction, availability, classification, relative merits and demerits.
**Solar Cells:** Theory of solarcells. solarcell materials, solarcellarray, solar callower plant, limitations.

### UNIT-II

**Solar Thermal Energy:** Solar radiation, floatplane collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**UNIT-III**

**Geothermal Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electricalconversion, non-electricalconversion,environmentalconsiderations.
Magneto-hydrodynamics (MHD):
Principle of working of MHD Power plant, performance and limitations

**FuelCells:**

Principle of working of various type souffle cell sand their working, performance and limitations.

**UNIT-IV**

Thermos and the rmionic Conversions:
Principle of working, performance and limitations.
**Wind Energy:** Wind power and it surcease, sites election, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitation sofenergy conversion systems.

**UNIT-V**

**Bio-mass:**Availability of bio-massand its conversion theory.
Ocean Thermal Energy Conversion (OTEC):
Availability, theory and working principle, per formance and limitations.
Wave and Tida lWave:
Principle of working, performance and limitations.Waste RecyclingPlants.

**TEXT/REFERENCESBOOKS**

1. John Twideu and TonyWeir, “Renewal Energy Resources” BSP Publications, 2006.
2. M.V.R.KoteswaraRao, “Energy Resources: Conventional&Non-Conventional “ BSPPublications,2006.
3. D.S.Chauhan, ”Non-conventional Energy Resources” New Age International.
4. C.S. Solanki, “Renewal Energy Technologies: A Practical Guidefor Beginners” PHILearning.