

University of Mumbai




No. AAMS_UGS/ICC/2022-23/ 174

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to the syllabus uploaded by Academic Authority Meetings & Services which was accepted by the Academic Council at its meeting held on 14th July, 2016 vide item No. 4.63 relating to the revised syllabus as per the (CBCGS) for M.E. (Civil Engineering) Structural Engineering.

You are hereby informed that the recommendations made by the Board of Studies in **Civil Engineering** at its meeting held on 6th June, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 vide item No. 6.18 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 vide item No. 6.18 (R) and that in accordance therewith, the revised syllabus of **M.E. (Structural Engineering) (Sem.- I to IV) (CBCS) (REV-2022 Scheme)**, has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
19th November, 2022


(Prof. Sunil Bhirud)
I/c Registrar

To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.18 (R)/11/07/2022

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Civil Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Director, Department of Information & Communication Technology,
- 6) The Co-ordinator, MKCL.

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

AC – 11 July, 2022

Item No. – 6.18 (R)

University of Mumbai



**Revised Syllabus for
M.E. (Structural Engineering)
(Sem. - I to IV)
(Choice Based Credit System)**

(With effect from the academic year 2022-23)

University of Mumbai



| | | |
|---|------------------------|--|
| O: _____ | Title of Course | M.E. (Structural Engineering) |
| O: _____ | Eligibility | Passed B.E./B.Tech and as per the Ordinance 5134 |
| R: _____ | Passing Marks | 45% |
| No. of years/Semesters: | | 2 years / 4 semesters |
| Level: | | P.G. / U.G./ Diploma / Certificate |
| Pattern: | | Yearly / Semester |
| Status: | | New / Revised |
| To be implemented from Academic Year : | | With effect from Academic Year : 2022-23 |

Dr. Suresh K. Ukarande
Chairman,
Board of Studies in Civil
Engineering

Dr. Suresh K. Ukarande
Associate Dean,
Faculty of Science and
Technology University of
Mumbai

Dr Anuradha Majumdar
Dean,
Faculty of Science and
Technology University of
Mumbai

Semester I

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | | |
|-------------|--|---------------------------------|-----------------|------|------------------|-------------------------|-----------|--------------|-------|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total | |
| STRC101 | Theory of Elasticity and Elastic Stability | 3 | -- | -- | 3 | -- | -- | 3 | |
| STRC102 | Structural Dynamics | 3 | | -- | 3 | | -- | 3 | |
| STRPE101X | Program Elective 1 | 3 | -- | -- | 3 | -- | -- | 3 | |
| STRPE102X | Program Elective 2 | 3 | -- | -- | 3 | -- | -- | 3 | |
| STRIE101X | Institute Elective 1 | 3 | -- | -- | 3 | -- | -- | 3 | |
| STRL101 | Program Lab-I | -- | 2 | -- | -- | 1 | -- | 1 | |
| STRSBL101 | Skill Based Lab-I | -- | 4 ^{\$} | -- | -- | 2 | -- | 2 | |
| Total | | 15 | 06 | -- | 15 | 03 | -- | 18 | |
| Course Code | Course Name | Examination Scheme | | | | | | | |
| | | Theory | | | | | Term Work | Pract / Oral | Total |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | | | |
| | | Test-1 | Test-2 | Avg | | | | | |
| STRC101 | Theory of Elasticity and Elastic Stability | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRC102 | Structural Dynamics | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRPE101X | Program Elective 1 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRPE102X | Program Elective 2 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRIE101X | Institute Elective 1 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRL101 | Program Lab-I | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| STRSBL101 | Skill Based Lab-I | -- | -- | -- | -- | -- | 50 | 50 | 100 |
| Total | | -- | -- | 100 | 400 | -- | 75 | 75 | 650 |

Semester I

| Program Elective 1 | | Program Elective 2 | |
|---------------------------|---|---------------------------|---|
| Course Code | Course Name | Course Code | Course Name |
| STRPE1011 | Advanced Numerical Methods | STRPE1021 | Analysis and Design of Multi-storey Buildings |
| STRPE1012 | Analysis of Composite Structures | STRPE1022 | Advanced Design of Concrete Structures |
| STRPE1013 | Advanced Pre-stressed Concrete Structures | STRPE1023 | Ground Improvement Techniques |
| STRPE1014 | Advanced Geotechnical Engineering | STRPE1024 | Advanced Structural Mechanics |

| Institute Level Elective-1 (Any One) | | | |
|---|--------------------------------|-----------|---|
| STRIE1011 | Product Life Cycle Management | STRIE1016 | Cyber Security and Laws |
| STRIE1012 | Reliability Engineering | STRIE1017 | Disaster Management and Mitigation Measures |
| STRIE1013 | Management Information Systems | STRIE1018 | Energy Audit and Management |
| STRIE1014 | Design of Experiments | STRIE1019 | Development Engineering |
| STRIE1015 | Operations Research | | |

Semester II

| Course Code | Course Name | Teaching Scheme(Contact Hours) | | | Credits Assigned | | | |
|--------------|-----------------------------|--------------------------------|-----------------|-----------|------------------|-----------|-----------|-----------|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| STRC201 | Finite Element Analysis | 3 | -- | -- | 3 | -- | -- | 3 |
| STRC202 | Theory of Plates and Shells | 3 | | -- | 3 | | -- | 3 |
| STRPE201X | Program Elective 3 | 3 | -- | -- | 3 | -- | -- | 3 |
| STRPE202 X | Program Elective 4 | 3 | -- | -- | 3 | -- | -- | 3 |
| STRILE201X | Institute Elective 2 | 3 | -- | -- | 3 | -- | -- | 3 |
| STRL201 | Program Lab-II | -- | 2 | -- | -- | 1 | -- | 1 |
| STRSBL201 | Skill Based Lab-II | -- | 4 ^{\$} | -- | -- | 2 | -- | 2 |
| Total | | 15 | 06 | -- | 15 | 03 | -- | 18 |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|-------------|-----------------------------|---------------------|----------|-----|------------------|-------------------------------|-----------|---------------------|-------|
| | | Theory | | | | | Term Work | Pract ./ Oral | Total |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | | | |
| | | Test - 1 | Test - 2 | Avg | | | | | |
| STRC201 | Finite Element Analysis | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRC202 | Theory of Plates and Shells | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRPE201X | Program Elective 3 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRPE202X | Program Elective 4 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRILE201X | Institute Elective 2 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| STRL201 | Program Lab-II | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| STRSBL201 | Skill Based Lab - II | -- | -- | -- | -- | -- | 50 | 50 | 100 |
| Total | | -- | -- | 100 | 400 | -- | 75 | 75 | 650 |

Note 1

Skill Based Lab- I and II are focused on the learning through experience. SBL shall facilitate the learner to acquire the fundamentals aspect of practical engineering in his or her specialization in a project-oriented learning environment. The learning through skill base can be useful in facilitating their research work and hence useful in early completion of their dissertation.

Semester II

| Program Elective 3 | | Program Elective 4 | |
|--------------------|--|--------------------|---|
| Course Code | Course Name | Course Code | Course Name |
| STRPE2011 | Earthquake Engineering | STRPE2021 | Design of Industrial Structure |
| STRPE2012 | Health Monitoring and Rehabilitation of Structures | STRPE2022 | Design of Green Buildings |
| STRPE2013 | Advanced Concrete Technology | STRPE2023 | Analysis and Design of Environmental & Hydraulic Structures |
| STRPE2014 | Advanced Finite Element Methods | STRPE2024 | Design of Bridge Structures |

| Institute Level Elective-II (Any One) | | | |
|---------------------------------------|---|-----------|-----------------------------|
| STRIE2011 | Project Management | STRIE2016 | Research Methodology |
| STRIE2012 | Finance Management | STRIE2017 | IPR and Patenting |
| STRIE2013 | Entrepreneurship Development and Management | STRIE2018 | Digital Business Management |
| STRIE2014 | Human Resources Management | STRIE2019 | Environment Management |
| STRIE2015 | Professional Ethics and Corporate Social Responsibility (CSR) | | |

Semester III

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | | |
|-------------|-----------------------------------|------------------------------------|--------|------|------------------|-------------------------------|-----------|----------------|-------|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total | |
| STRMP301 | Major Project: Dissertation -I | -- | 20 | -- | -- | 10 | -- | 10 | |
| Total | | 00 | 20 | 00 | 00 | 10 | -- | 10 | |
| Course Code | Course Name | Examination Scheme | | | | | | | |
| | | Theory | | | | | Term Work | Pract/ Oral | Total |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | | | |
| | | Test-1 | Test-2 | Avg | | | | | |
| STRMP301 | Major Project: Dissertation -I | -- | -- | -- | -- | -- | 100 | -- | 100 |
| Total | | -- | -- | -- | -- | -- | 100 | -- | 100 |

Online Credit Courses

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|--------------|---------------------------|------------------------------------|--------|------|---------------------|-----------|-----------|-----------|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| STROCC301 | Online Credit Course - I | -- | -- | -- | -- | -- | -- | 3 |
| STROCC302 | Online Credit Course - II | -- | -- | -- | -- | -- | -- | 3 |
| Total | | -- | -- | -- | 00 | 00 | 00 | 06 |

Note 2: It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by UOM. These two courses shall be completed in any semester I or II or III, but no later than end of the Semester III. University shall make a provision that credits earned with OCC- I and OCC-II shall be accounted in the third semester grade-sheet with actual name of courses. The learner shall be allowed to take up these courses from his or her institute or organization/ industry where his / her major project is carried out. The candidate shall complete the courses and qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner.

Online Credit Course – I

The learner shall opt for the course in the domain of Research Methodology or Research & Publication Ethics or Intellectual Property Rights. The opted course shall be of 3 credits of equivalent number of weeks.

Online Credit Course –II

The learner shall opt for the course recommended by Faculty Advisor/ Project Supervisor from the institute. The opted course shall be of 3 credits of equivalent number of weeks.

Semester IV

| Course Code | Course Name | Teaching Scheme (Contact Hrs) | | | Credits Assigned | | | | |
|-------------|---------------------------------|-------------------------------|--------|------|------------------|-------------------|-----------|-------------|-------|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total | |
| STRMP401 | Major Project: Dissertation -II | -- | 32 | -- | -- | 16 | -- | 16 | |
| Total | | -- | 32 | -- | -- | 16 | -- | 16 | |
| Course Code | Course Name | Examination Scheme | | | | | | | |
| | | Theory | | | | | Term Work | Pract/ Oral | Total |
| | | Internal Assessment | | | End Sem. Exam | Duration (in Hrs) | | | |
| | | Test-1 | Test-2 | Avg | | | | | |
| STRMP401 | Major Project: Dissertation -II | -- | -- | -- | -- | -- | 100 | 100 | 200 |
| Total | | -- | -- | -- | -- | -- | 100 | 100 | 200 |

Total Credits: 68

Note 3: The Dissertation -II submission shall not be permitted till the learner completes all the requirements ME course.

Note 4: The contact hours for the calculation of load of the teacher for Major Project are as follows:
Major Project Dissertation I and II - 02 Hour / week / student

Guidelines for Dissertation-I

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format. Guidelines for Assessment of Dissertation-I.

Dissertation-I should be assessed based on following points

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization
- Clarity of objective and scope Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

Dissertation II should be assessed based on following points:

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Quality of work attempted or learner contribution

- Validation of results
- Quality of Written and Oral Presentation

Students should publish at least one paper based on the work in referred National/ International conference/Journal of repute.

Dissertation II should be assessed by internal and External Examiners appointed by the University of Mumbai.

Semester I

Semester I

| Course Code | Course Name | Credits |
|-------------|--|---------|
| STRC101 | Theory of Elasticity and Elastic Stability | 03 |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | - | - | 03 |

| Theory | | | | | Term Work/ Practical/Oral | | | Total |
|---------------------|-------------|---------|--------------------|--------------------------------|------------------------------|--------|------|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | Term Work | Pract. | Oral | |
| Test- I | Test -II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 hours | - | - | - | 100 |

Rationale

Theory of Elasticity and Elastic Stability is a vital branch of Mechanics of deformable Bodies. There are many practical cases where elementary methods of Strength of Materials are insufficient to provide detailed information regarding stress distribution around Engineering Structures. A course in Theory of Elasticity and Elastic Stability is necessary for structural engineering students to understand the behaviour of elastic solids under applied loads. This course introduces more powerful methods to investigate the deformations and stress distributions of elastic solids. This course also focuses on the fundamental concepts of structural stability.

Objectives

1. To analyse the stresses and strains for two dimensional elements in Cartesian and polar coordinate systems.
2. To understand how to apply the compatibility conditions and equations of equilibrium.
3. To solve elementary problems of elasticity in three-dimensional Coordinate system.
4. To understand the basic concept of elastic stability and buckling.
5. To analyse buckling behaviour of conventional structural components.
6. To apply the concepts of lateral and torsional buckling in analysis of beams.

| Detailed Syllabus | | | |
|-------------------|-------------------------------------|--|-----|
| Module | Course Module / Contents | | Hrs |
| 1 | Theory of Elasticity- I | | 5 |
| | 1.1 | Introduction: Elasticity, Notations for forces and stresses, components of stresses, components of strain, Hooke's law | |
| | 1.2 | Plane stress and plane strain analysis: stress at a point, strain at a point | |
| | 1.3 | Differential equations of equilibrium, boundary conditions, Strain Displacement Relations | |
| | 1.4 | Compatibility equations | |
| 2 | Theory of Elasticity - II | | 8 |
| | 2.1 | Two dimensional problems in rectangular coordinates: – Airy's Stress function, Biharmonic Equation,solution by polynomials | |
| | 2.2 | Saint-Venant's principle, bending of a cantilever loaded at the end, bending of a uniformly loaded simply supported beam. | |
| | 2.3 | Two dimensional problems in polar coordinates: - equations of equilibrium in polar coordinates | |
| | 2.4 | Bending of curved bars by a concentrated force | |
| | 2.5 | Rotating circular disc | |
| | 2.6 | Stress concentration around circular holes | |
| 3 | Theory of Elasticity III | | 8 |
| | 3.1 | Analysis of Three-Dimensional Problems: General Theorems, Differential equations of equilibrium, conditions of compatibility | |
| | 3.2 | Equations of equilibrium in terms of displacements, principle of super position, uniqueness of solution, Reciprocal theorem | |
| | 3.3 | Elementary problems of elasticity in three dimensions: Twist of Circular shafts Pure bending of Prismatic bars, plates | |
| | 3.4 | Torsion of prismatic bars, Membrane analogy | |
| 4 | Elastic Stability | | 5 |
| | 4.1 | Concepts of elastic stability, different forms of structural instability | |
| | 4.2 | BEAM-COLUMNS: differential equation for beam columns. Analysis of beam columns with different load cases and support conditions. | |
| 5 | Elastic Buckling of Bars and Frames | | 6 |
| | 5.1 | COLUMNS: Euler's buckling load, Governing differential equation, standard cases of columns with different | |

| | | | |
|----------|---------------------------------------|---|----------|
| | | boundary conditions, elastically restrained columns, eccentrically loaded columns. Energy methods for buckling problems | |
| | 5.2 | Buckling of single span frames | |
| | 5.3 | Buckling of Continuous beams | |
| 6 | Buckling in Structural Members | | 6 |
| | 6.1 | Torsional buckling: Pure torsion of thin-walled bars of open cross section, torsional buckling, | |
| | 6.2 | Buckling by torsion and flexure | |
| | 6.3 | Lateral Buckling of beams: differential equation for lateral buckling, lateral buckling of beams in pure bending | |

Contribution to Outcome

On completion of this course, the students will be able to:

- 1 Understand the elastic behaviour of materials.
- 2 Apply concepts of stress-strain relations for linearly elastic solids.
- 3 Derive governing equations for 2D and 3D elastic problems.
- 4 Analyse torsion in prismatic members.
- 5 Understand the various numerical methods for treatment of stability problems.
- 6 Analyse buckling behaviour of conventional structural components.

Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

- 1 Timoshenko, S., and Goodier, T.N., 'Theory of Elasticity', *McGraw- Hill Book Co.Inc*

- 2 Timoshenko, S.: 'Theory of Elastic Stability', *McGraw Hill Book Co.Inc*
- 3 Wang: 'Applied Elasticity', *McGraw Hill Book Co.Inc*
- 4 L S Srinath: 'Advanced Mechanics of Solids' *Tata McGraw Hill*
- 5 Aswini Kumar: 'Stability Theory of Structures', *McGraw Hill Book Co.Inc.*
- 6 N.G.R. Iyengar: 'Structural Stability of Columns and Plates', *Affiliated East West Press*
- 7 Mohammed Ameen: 'Computational Elasticity' *Narosa Publishing House*
- 8 Boresi A.P, Chang K.P, Lee J.D, 'Elasticity in Engineering Mechanics' *John Wiley & Sons Inc.*
- 9 Sitharam T.G, Govindaraju L, 'Theory of Elasticity' *Springer*
- 10 Brush, D.O. and. Almorh, B.O.: 'Buckling of Bars, Plates and Shells', *McGraw Hill, Kogakusha Ltd.*
- 11 Sadhu Singh: 'Theory of Elasticity' *Khanna Publishers*

Reference Books:

- 1 Fung Y.C.: 'Foundations of Solid Mechanics' *Prentice-Hall Inc.*
- 2 Den Hartog J.P. 'Advanced Strength of Materials' *Dover Publishing*
- 3 Shames I.H: 'Mechanics of Deformable Bodies' *Kreiger Publishing Co.*
- 4 Hearn E.J: 'Mechanics of Materials 2' *Elsevier Science*
- 5 Sadd,M. H. "Elasticity: Theory, Applications and Numeric", *Academic Press*

| Semester I | | |
|-------------|---------------------|---------|
| Course Code | Course Name | Credits |
| STRC102 | Structural Dynamics | 3 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 3 Hrs | -- | -- | -- | 100 |

Rationale

Conventional structural analysis is based on the concept of static forces, whereas in present course structures are subjected to dynamic loading conditions. Structural Dynamics is an extension of the conventional static structural analysis, which considers the effect of time varying forces. Although much less used by practicing engineers than conventional structural analysis, the use of Structural Dynamics has gradually increased with worldwide acceptance of its importance. At present, it is being used for the analysis of tall/ high rise buildings, bridges, towers subjected to blast sway forces/load, wind, earthquake etc. Partial or complete collapse of structures occurs due to devastating earthquakes, which leads to great loss of life and livelihood. The lateral loads due to earthquake acting on structure are calculated using theory of structural dynamics. Therefore, the understanding of structural dynamics, characteristic of earthquakes and its effect on structure is essential for safe design of civil engineering structures.

Course Objectives

- 1 Study the various types as well as characteristics of loading and formulate the equations of motion.
- 2 Learn the response of un-damped and damped SDOF systems under various loadings.
- 3 Employ the approximate and iterative methods to model continuous vibratory systems.

- 4 Use the seismic codes in analysis and design of civil engineering structures.
- 5 Understand the dynamic response by numerical methods.
- 6 Learn the response of un-damped and damped MDOF systems under various loadings

Detailed Syllabus

| Module | Course Module / Contents | | Contact hours |
|----------|--|--|---------------|
| I | Introduction to Structural Dynamics | | 4 |
| | 1.1 | Purpose of dynamic analysis, Static and Dynamics Loads, Nature of exciting forces, Loading Classifications, Basic terms | |
| | 1.2 | Degrees of freedom, Dynamic influence, mathematical modelling of dynamic systems, Response of structure, Effective stiffness | |
| 2 | Single Degree of Freedom (SDOF) Systems | | 13 |
| | 2.1 | Equations of Motions by Simple harmonic motion, Newton's law of motion, Energy method and D'Alembert's Principal. | |
| | 2.2 | Response of un-damped and damped free vibrations of SDOF systems | |
| | 2.3 | Damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement | |
| | 2.4 | Response of un-damped and damped forced vibrations of SDOF systems, Dynamic magnification factor, transmissibility | |
| | 2.5 | Response of structure subjected to General dynamic load, Duhamel's Integral Numerical Evaluation of Dynamic Response of SDOF systems | |
| | 2.6 | Response of structure in frequency domain subjected to non-periodic forces: suddenly applied load-step and ramp excitation and impulsive force of short duration: Half-sine pulse - Rectangular pulse - Triangular Pulse, Dynamic load factor. | |
| | 2.7 | Distributed mass system idealized as SDOF system, use of Rayleigh's method. Response of SDOF system subjected to ground motion | |
| 3 | Lumped Mass Multi-Degree of Freedom (MDOF) System, Coupled And Uncoupled System | | 09 |
| | 3.1 | Direct determination of frequencies of vibration and mod shape. | |
| | 3.2 | Orthogonality principle. | |
| | 3.3 | Vibration of MDOF systems with initial conditions | |
| | 3.4 | Approximate method of determination of natural frequencies of vibration and mode shapes – Vector Integration Method | |

| | | | |
|----------|--|--|-----------|
| | 3.5 | Energy methods and use of Lagrange's method in writing equation of motions decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness. | |
| | 3.6 | Forced vibration of MDOF system, Modal Analysis. Application to multi-storey rigid frames subjected to lateral dynamic loads. | |
| | 3.7 | Concepts of Tuned Mass Dampers | |
| 4 | Structure with Distributed Mass System, Use of Partial Differential Equation. | | 04 |
| | 4.1 | Free vibration analysis of single span beams with various boundary conditions, determination of frequencies of vibration and mode shapes | |
| 5 | Earthquake Analysis | | 09 |
| | 5.1 | Introduction, Elastic rebound theory, Tectonic plates, Plate boundary, Faults, seismic waves, Seismicity of a region, causes and mitigation of earthquake | |
| | 5.2 | Measurement of Earthquake ground motion, Intensity of earthquake, Richter Scale, Seismogram, construction of seismograph | |
| | 5.3 | I.S code provisions for seismic analysis of buildings. | |
| | 5.4 | Approximate method of earthquake analysis– Seismic co-efficient method and its limitation Introduction to history analysis. | |
| | 5.5 | Application of modal analysis concept to seismic disturbance, Response spectrum method. | |

Contribution to Outcome

On completion of this course, the learner will be able to

- 1 Know the fundamental theory of dynamic equation of motions and analysis methods for dynamic systems.
- 2 Evaluate the response of SDOF and MDOF systems to different types of dynamic loads including ground motions.
- 3 Understand the basics of random vibrations and the application of this concept to analyze Linear SDOF systems
- 4 Interpret the dynamic analysis results for design, analysis and research purposes.

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 There can be an internal choice in various sub-questions/questions in order to accommodate the questions on all the topics/ sub-topics.
- 3 The students will have to attempt any four questions out of total six questions
- 4 The questions can be of mixed nature irrespective of modules

Recommended Books:

- 1 Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications
- 2 Dynamics of structures--Poultre, Wiley India
- 3 R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications
- 4 R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications.
- 5 Madhujit Mukhopadhyay – Structural Dynamics Vibrations and Systems, Ane Books India Publishers
- 6 John M. Biggs: ‘Structural Dynamics’; Tata Mc-Graw Hill.

Reference Books:

- 1 Mario Paz – Structural Dynamics Theory and Computation, CBS Publications
- 2 Craig R.R.: ‘Structural Dynamics-An Introduction to Computer Methods’; John Wiley and Sons.
- 3 IS: 1893 (Part-I)- 2016: Criteria For Earthquake Resistant Design of Structures
- 4 IS:13920-2016: Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice

Semester I

| Course Code | Course Name | Credits |
|-------------|--|---------|
| STRPE1011 | Program Elective I:Advanced NumericalMethods | 03 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/ Practical/Oral | | | Total |
|---------------------|---------|---------|--------------------|--------------------------------|------------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hours | - | - | - | 100 |

Rationale

Classical theory-based analysis of various Civil Engineering problems involves solution of higher degree differential/integral /simultaneous/nonlinear etc equations. Thus solving these equations becomes time consuming clumsy and complicated process. Hence it involves the use of Numerical methods for solving these classical based higher degree equations. Though the Numerical methods involves laborious process, the availability of computational tools are utilised to get the approximate solutions.

Course Objectives

The objectives of this course are

1. To master basic Programming fundamentals, Fundamentals of numerical methods
2. Determine errors present in numerical solutions to engineering problems.
3. Utilize programming logic, structure and syntax to develop multifunctional algorithms to solve engineering problems
4. Identify and classify the numerical problem to be solved.
5. Choose the most appropriate numerical method for its solution based on characteristics of the problem
6. Understand the characteristics of the method to correctly interpret the results.

Detailed Syllabus

| Module | Course Module / Contents | Contact hours |
|--------|--|---------------|
| 1 | Introduction: | 5 |
| | Rootsofanon-linearequationandRootsofapolynomialofnthdegree [Incrementalsearchmethod;Methodsofsuccessiveapproximations;Newton'smethod; Bisectionmethod;Secantmethod;Müller's method;Syntheticdivision;Bairstow's method]andconvergencestudy. | |
| 2 | Solutionof(non-homogeneous)linearalgebraicequations: | 3 |
| | Reviewofmatrixalgebra;Gausseliminationmethod;Cholesky'sdecompositionmetho d;Householdermethod; Gauss-Seidaliterativemethod | |
| 3 | Solutionofnon-linearalgebraicequations: | 4 |
| | Methodsofsuccessiveapproximation; Newton'smethod;ModifiedNewton–Raphsonmethod;Secantmethod | |
| 4 | EigenvaluesandEigenvectors: | 5 |
| | ReductionofgeneralizedEigenvalueproblemtothestandardEigenvalueproblem;meth ods forobtainingEigen values and Eigenvector [Polynomialmethod;Vectoriterationmethod;Misespowermethod;Jacobimethod]. | |
| 5 | Time marchingschemesfor solutionof problems in timedomain: | 5 |
| | Numerical integration (2–D)[Newton–Cotesmethod;Gauss–Legendremethod]. | |
| 6 | Solutionofdifferenialequations: | 7 |
| | Ordinaryandpartialdifferenialequations,Taylorseries, Euler's method; Runge – Kutta method; Simple applications in structural mechanicssuchascriticalloadsofstruts,beamcolumns,Solutionoftranscendentalequat ion, applicationsofbucklingofsimpleportalframes | |
| 7 | Finitedifferencemethod: | 5 |
| | Simpleapplicationstoproblemsofbeamandplates,Laplacian equation,consolidationequation,laterallyloadedpilesetc. | |
| 8 | RegressionAnalysis: | 5 |
| | Leastsquare method,PolynomialfunctioncurvefittingInterpolation- Polynomialapproximation,Lagrangemethod,Splineinterpolation | |

Contribution to Outcomes

Upon successful completion of the course, students should have an ability of

1. Root finding; solutions for nonlinear algebraic equations
2. Solving sets of linear equations
3. Interpolation and curve fitting models
4. Numerical Differentiation and Integration
5. Understand fundamentals of numerical methods.

Internal Assessment**20 Marks**

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:**End Semester Examination****80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

- 1 Chapra, S.C. and Canale R.P.: 'Numerical Methods for Engineering', *Tata McGraw Hill*
- 2 Carnahan, B., Luther, H.A. and Wilkes, J.O.: 'Applied Numerical Methods', *John Wiley*
- 3 Heath, M.T.: 'Scientific Computing: An Introductory Survey', *McGraw Hill*
- 4 Douglas Faires, J. and Richard Burden: 'Numerical Methods', *Thomson*
- 5 Rajasekaran, S.: 'Numerical Methods in Science and Engineering', *S. Chand*
- 6 E. Balguruswamy: 'Numerical Methods', *TMH Publications*
- 7 Pallab Ghosh: 'Numerical Methods with Computer Programming in C++', *PHI Pvt. Ltd.*
- 8 John F. Flemming: 'Computer Analysis of Structural Systems', *Mc Graw Hill International Edition*
- 9 Atkinson, K.E.: 'An Introduction to Numerical Analysis', *J. Wiley and Sons*
- 10 Wilkinson, J.H.: 'The Algebraic Eigenvalue Problems', *Oxford University Press.*

Semester I

| Course Code | Course Name | Credits |
|------------------|---|-----------|
| STRPE1012 | Analysis of Composite Structures | 03 |
| | Program Elective-I | |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-----------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

| Theory | | | | | Term Work/Practical/Or al | | | Total |
|---------------------|-------------|-------------|--------------------|--------------------------------|---------------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test -I | Test- II | Aver age | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

Course Objectives

The objectives of this course are

1. To introduce the general set of composite materials
2. To show the advantages of composites over metals
3. To explain the fabrication processes
4. To analyse the structural mechanics of composite materials.
5. To explain the deformation and failure of composite materials under the influence of different loads.
6. To know the effect of hydro-thermal environment on composite materials

Detailed Syllabus

| Module | Course Modules / Contents | Contact hours |
|--------|---|---------------|
| 1 | Introduction | 05 hrs |
| | Definition of fiber reinforced composites, applications and various reinforcement and matrix materials. . | |
| 2 | Mechanics of a Lamina | 10 hrs |
| | Linear elastic stress-strain relations, elastic constants based on micromechanics, plane stress constitutive relations, transformation of stresses and strains transformation of material coefficients, thermal stresses and strains | |
| 3 | Laminated Composites | 10hrs |
| | Types of laminated composites, displacement field approximations for classical laminate theory, laminate strains, stress resultants, stiffness matrices, stresses and strains due to applied loads, introduction to first order shear deformation theory. | |
| 4 | Failure Theories of a Lamina | 08hrs |
| | Maximum stress failure theory, maximum strain failure theory, Tsai-Hill failure theory, Tsai-Wu failure theory | |
| 5 | Mechanical Properties Determination | 06 hrs |
| | Tensile properties, compressive properties, flexure properties, in-plane shear properties, inter laminar shear strength. | |
| | Total | 39 |

Contribution to Outcome

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

1. Learn use of composite materials in real structures.
2. Use Composite material: classification, characterization, fabrication techniques.
3. Structural mechanics of composite materials: Calculation of strength and stresses.
4. De lamination, knowledge about inters laminar stresses.
5. Environmental effect on composite material.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

- 1) Composite structure of steel and concrete (by Johnson)
- 2) Mechanics of composite material and structure by M. Mukhopadhyay (university press)
- 3) An Introduction to Composite Material by D. Hull (Cambridge University Press)
- 4) Engineering Mechanics of Composite Material by Isaac M. Daniel & Ori Ishai (OUP)
- 5) Steel Concrete and Composite Design of Tall Building by Bungu

Reference Books

1. Jones R. M., Mechanics of Composite Materials, McGraw-Hill, Kogakusha Ltd., Tokyo, 1975.
2. Agarwal B. D. and Broutman L. J., Analysis and Performance of Fiber Composites, John Wiley and Sons, 1980.
3. Kaw A. K., Mechanics of Composite Materials, CRC Press, Florida, 1997.
4. Hyer M. W., Stress Analysis of Fiber-Reinforced Composite Materials, McGraw Hill, 1999.
5. Mukhopadhyay M., Mechanics of Composite Materials and Structures, University Press, India, 2004.
6. Daniel and Ishai, Engineering Mechanics of Composite Materials, Oxford University Press, 2005.
7. Christensen R. M., Mechanics of Composite Materials, Dover Publications, New York, 2005.
8. MotaSoares C. A., MotaSoares C. M., and Freitas Manuel J.M., Mechanics of Composite Materials and Structures (Proceedings), Springer Science & Business Media, 1999

| CourseCode | CourseName | Credits |
|------------|---|---------|
| STRPE1013 | Advanced Pre-stressed Concrete Structures | 03 |
| | Program Elective-1 | |

TeachingScheme

| ContactHours | | | Creditsassigned | | | |
|--------------|-----------|----------|-----------------|-----------|-----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorials | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | Total |
|--------------------|--------|---------|------------|------------------------|-------------------------|-----|-----|-------|
| InternalAssessment | | | EndSemExam | Duration ofEnd SemExam | TW | P R | O R | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | -- | -- | 100 |

Rationale

Pre-stressed concrete combines high strength steel and high strength concrete in an active manner. Today, pre-stressed concrete is being used in the construction of wide range of structures. It helps an engineer to achieve a much economical section for carrying heavy loads over larger span lengths. Thus, the use of pre-stressed concrete has become a standard practice for long span bridges. A Prestressed Concrete section improves performance/efficiency, reduces structural thickness, and material savings compared with reinforced cement concrete sections. This course involves typical applications of prestressed concrete that include Beam, Slab and Frame, Shells and Folded Plate Structures. Pre-stress concrete pipes, tanks, poles, piles, sleepers and pavements, bridges and composite constructions etc.

Course Objectives

1. To understand the basic concepts of in pre-stressed concrete structures in relation to its applications.
2. To study the design of prestressed concrete Beam, Slab and portal Frames.
3. To understand the design concepts of Shells and Folded Plate Structures.
4. To study the design of Pre-stress concrete Pipes, tanks, poles, piles, sleepers and pavements.
5. To study the design of prestressed concrete bridges.
6. To understand the design concepts of Composite construction of Prestressed and in situ concrete.

Detailed Syllabus

| Module | Course Modules / Contents | Periods |
|-----------|--|---------------|
| 1 | Introduction: Introduction to Prestressed concrete, system and devices, materials, losses in pre-stress, stresses at transfer and service loads, maintenance of pre-stressed concrete structure, limit state method-limit state of collapse against flexure, shear, torsion-limit state of serviceability. Short term and long term deflection of uncracked members. | 05 Hrs |
| 2. | Beam, Slab and Portal Frame: Continuous beams-primary and secondary moments—Elastic analysis of continuous beams. Design of one way and two way slabs. Design of Flat slabs. Analysis and design of Grid floors. Design of Prestressed portal frames. | 08 Hrs |
| 3 | Shells and Folded Plate Structures: Shells: method of pre-stressing, design of circular cylindrical shell and hyperboloid shell. Folded Plate: Introduction, different cross section of folded plates, deformation characteristic of folded plate, Design of folded plate structures. | 07 Hrs |
| 4 | Pre-stress concrete Pipes, tanks, poles, piles, sleepers and pavements: Introduction, principal of circular pre-stressing, methods of design, General analysis and design of Prestressed concrete pipes, design of Liquid storage tanks, Ring beams, poles, piles sleepers and pavements. | 06 Hrs |

| | | |
|----------|--|---------------|
| 5 | Pre-stress concrete bridges: Introduction, Pre-tensioned and post-tensioned concrete bridge decks; analysis of section for flexure, shear and bond; Design of post-tension prestressed concrete slab bridge deck, T-beam slab bridge decks; analysis and design of anchorage block; box girder bridge. | 07 Hrs |
| 6 | Composite construction of Prestressed and in situ concrete : Composite Section of pre-stressed concrete beam and cast in situ RC slab- analysis of stresses, differential shrinkage, deflections, flexure, and shear strength of composite section, analysis and design of composite section. | 05 Hrs |

| |
|---------------------------------|
| Contributions to Outcome |
|---------------------------------|

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

1. Understand the basic concepts of in pre-stressed concrete structures in relation to its applications
2. Study the design of prestressed concrete Beam, Slab and portal Frames.
3. Understand the design concepts of Shells and Folded Plate Structures.
4. Study the design of Pre-stress concrete Pipes, tanks, poles, piles, sleepers and pavements.
5. Study the design of prestressed concrete bridges.
6. Understand the design concepts of Composite construction of Prestressed and in situ concrete

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either test. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions. Question number one will be compulsory and will have the weightage of 32 marks.
2. The students will have to attempt **any three** questions out of **remaining five** questions which will be having the weightage of 16 marks each.
3. There can be an **internal** choice in various sub-questions/questions in order to accommodate the questions on all the topics/ sub-topics.

4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Krishna Raju (2000): 'Prestressed Concrete', *Tata McGraw Hill Publishing Co.*
2. Sinha, N. C. and Roy, S. K. (1998): 'Fundamentals of Prestressed Concrete', *S. Chand and Co.*
3. V. K. Raina (1994): 'Concrete Bridge Practice Analysis Design and Economics', *Tata McGraw Hill, 2nd Edition, 1994.*
4. S. Ramamrutham (2013): 'Prestressed Concrete', *Dhanpat Rai Publishing Company*
5. Lin, T. Y. and Burns, N. H. (2004): 'Design of Prestressed Concrete Structures', *3rd Edition, John Wiley and Sons.*
6. IS: 1343, "Code of Practice of Prestressed Concrete", *Indian Standards Institution.*

Semester I

| Course Code | Course Name | Credits |
|-------------|-----------------------------------|---------|
| STRPE1014 | Advanced Geotechnical Engineering | 03 |
| | Program Elective-I | |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

Rationale

The present syllabus is designed assuming that the students have the prerequisite knowledge of basic geotechnical engineering at their UG level. All the structures, except those flying, or floating, rest on soil, and or rock. The basic philosophy of this syllabus is to address the overview of geotechnical engineering concepts, laboratory and field tests, data interpretation and various geotechnical applications keeping in view that the students must be aware of the importance of interactions between structural and geotechnical engineers. This course aims to confer the understanding of the various available geotechnical tests, design techniques and influencing factors, and different foundation systems.

Course Objectives

1. To impart knowledge on the various properties of soil, overview of different laboratory and field tests and some soil exploration techniques.
2. To understand the interpretation of data from field and laboratory tests.
3. To understand the different techniques to evaluate the bearing capacity of shallow foundation systems.
4. To understand the different techniques to evaluate the capacity of single pile and group of piles, overview of anchored sheet piles and deep excavation systems.
5. To understand the basic concept of soil dynamics and its application to the machine foundations.
6. To learn the necessity of stability of slopes, ground improvement, design of stone columns and vertical drains, and types of geosynthetics.

Detailed Syllabus

| Module | Course Module / Content's | | Contact Hours |
|----------|---|--|---------------|
| 1 | Overview of Geotechnical Engineering | | 8 |
| | 1.1 | Overview of Geotechnical Engineering; Definitions and scope of Soil Mechanics, Soil Dynamics, Rock Mechanics, etc. | |
| | 1.2 | Basic relationship among void ratio, porosity, degree of saturation, air content, %air voids, water content, specific gravity, bulk unit weight, dry unit weight, submerged unit weight, saturated unit weight, unit weight of soil solid, etc. | |
| | 1.3 | Hydraulic properties (an overview): Co-efficient of permeability, hydraulic gradient, total head, seepage phenomenon, uplift pressure; Basic understanding of effective stress principal; Consolidation properties: co-efficient of compression, co-efficient of consolidation, coefficient of compressibility (a_v), m_v , degree of consolidation, pre-consolidation pressure, normally and over-consolidated soil; Shear parameters: cohesion (c), angle of internal friction (ϕ), adhesion, angle of wall friction. | |
| | 1.4 | Laboratory tests (an overview): water content, specific gravity, grain size distribution, field density tests (core cutter & sand replacement), standard and modified Proctor tests, permeability test, consolidation test, CBR test, etc.; Shear strength tests (direct shear and triaxial tests): Different types of tests based on drainage conditions (UU, $\bar{U}\bar{U}$ CU, $\bar{C}\bar{U}$, CD), relevance in field, i.e., how to choose which test to be carried out? (Note: A teacher may take a typical case of earth dam and show that all these cases are seen in one project itself.) | |
| | 1.5 | Overview of field tests: field permeability tests, field vane shear test, SPT, CPT (SCPT & DCPT), pressuremeter test (PMT), plate load test, pile load test, etc. | |

| | | | |
|----------|---|--|----------|
| | 1.6 | Soil exploration, number of boreholes & depth of exploration, sequence of boring & testing, boring procedure, size of boring in soil and rock, single, double&triple core barrels; soil samplers; Geophysical exploration: Seismic refraction, electrical resistivity | |
| 2 | Interpretation of Data from Field and Laboratory Tests | | 5 |
| | 2.1 | Plotting of cross-sectional profile (lateral and longitudinal) and how to take a decision on depth of foundation. (Note: Teacher may collect a typical geotechnical report from the nearby project and explain the same to the class.) | |
| | 2.2 | Analysis of results and graphs from consolidation test: determination of c_v , degree of consolidation; consolidation settlement; field method to estimate pre-consolidation pressure; graphical method to determine pre-consolidation pressure; methods to obtain field virgin compression curve. | |
| | 2.3 | Analysis of results and graphs from shear strength tests: deviator stress at failure, Mohr circles, c , ϕ ; Relations among σ_1 , σ_3 , c , ϕ . | |
| 3 | Shallow Foundation (A teacher can take a case study of nearby site and explain articles 3.1 to 3.6.) | | 6 |
| | 3.1 | Introduction to shallow foundation; modes of failure;ultimate versus net ultimate bearing capacity, factor of safety,allowable bearing capacity in soil. | |
| | 3.2 | Bearing capacity equations as per Vesic and IS code; influence of ground water table on bearing capacity;eccentric loading on footing. | |
| | 3.3 | Footing adjacent to slopes, footings on stratified soils, foundations on peat, expansive soil and highly compressible soil. | |
| | 3.4 | Determination of bearing capacity based on penetration tests (SPT, SCPT, DCPT), plate load test andpressuremeter test. | |
| | 3.5 | Allowable bearing pressure for permissible total settlement, Terzaghi-Peck, Meyerhoff, Peck-Hanson- | |

| | | | |
|----------|---|---|----------|
| | | Thornburnanalyses (equations and applications). | |
| | 3.6 | Bearing pressure on rock based on core strength, pressuremeter test. | |
| 4 | Pile Foundation (A teacher can take a case study of nearby site and explain articles 4.1 to 4.5) | | 8 |
| | 4.1 | Introduction to piles, pile classification, capacity of individual pile under axial vertical compression load; selection of design parameters: selection of test methods, types of strength parameters (drained/ undrained), generalized sub-soil profiles; pile capacity from static formulae, pile capacity in rock; pile capacity from dynamic formulae, validity of dynamic formulae. | |
| | 4.2 | Pile capacity from pile load test, standard penetration test (SPT) and cone penetration test (SCPT, DCPT);group efficiency of pile; pile group in sand and clay, group capacity of piles, settlement of pile group. Refer IS 2911 part 1 to part 4 and IRC 78. | |
| | 4.3 | Negative skin friction, steps to eliminate negative skin friction; under-reamed piles; length of fixity of pile | |
| | 4.4 | Anchored sheet piles (Pressure diagrams, application) | |
| | 4.5 | Deep excavation: braced cut, deep excavation with piles | |
| 5 | Soil Dynamics and Machine Foundation | | 7 |
| | 5.1 | Introduction to vibration; relationship between frequency and amplitude; free vibration without and with damper, forced vibration without and with damper (Single degree of freedom system, only final equations, derivations not required); logarithmic decrement | |
| | 5.2 | Wave propagation in an elastic infinite medium;method based on elastic half space; lumped mass approach; velocity of primary, secondary, Rayleigh and love waves;waves generated by a circular surface footing undergoing vertical oscillations; | |
| | 5.3 | IS 5249 - Determination of dynamic soil properties: block | |

| | | | |
|----------|---|---|----------|
| | | vibration, steady state vibration, down the hole, up the hole, cross borehole tests, cyclic plate load test. | |
| | 5.4 | Criteria of satisfactory machine foundation; methods of analysis; degrees of freedom of a block foundation; Definition of soil spring stiffness, Indian standard for design and construction of foundation for reciprocating machines, design procedure for a block foundation. | |
| 6 | Slope Stability, Geosynthetic and Ground Improvement | | 5 |
| | 6.1 | Stability of slopes based on methods of slices (Fellenius method) and Bishop's simplified method | |
| | 6.2 | Types and selection of ground improvement techniques (IS 13094) | |
| | 6.3 | IS 15284 part 1: Stone column; IS 15284 part 2: Preconsolidation using vertical drains; liquefaction and mitigation measures | |
| | 6.4 | Geo-synthetics types (basic concept): geo-textiles, geo-grids, geo-cell, geo-membrane, geo-composite, geo-net; multi-functions of geo-synthetics: separation, reinforcement, drainage, filtration, erosion control, etc.; How to select appropriate Geo-synthetics based on applications? | |

Contribution to Outcomes

On completion of this course, the learner will be able to

1. Evaluate soil properties by performing laboratory and field tests, and understand the necessity along with some techniques of soil exploration.
2. Analyze the obtained results from field and laboratory tests.
3. Understand modes of failure and evaluate bearing capacity of shallow foundation.
4. Estimate the safe load on single and group pile systems.
5. Understand the dynamic soil properties and get an overview of machine foundation systems.
6. Design safe slopes, understand the necessity of ground improvement, stone columns and pre-consolidation using vertical drains, select appropriate geo-synthetics based on applications.

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be of mixed in nature.
- 4 The students will have to attempt **any four** questions out of **total six** questions.

Recommended Books:

| | |
|---|---|
| 1 | Nayak, N. V.(2018), "Foundation Design Manual". <i>Dhanpatrai Publication</i> , New Delhi. |
| 2 | Singh, A. (2006), "Modern Geotechnical Engineering". <i>CBS Publishers and Distributors Pvt. Ltd.</i> , New Delhi. |
| 3 | Som, N. N. and Das, S. C. (2003), "Theory and Practice of Foundation Design". <i>Prentice Hall of India private limited</i> , New Delhi. |
| 4 | Terzaghi, K. and Peck, R. B. (1967), "Soil Mechanics in Engineering Practice". <i>2nd edition, John Wiley and sons, Inc.</i> , Canada. |
| 5 | Tomlinson, M. J. (1986), "Foundation design and construction". <i>7th edition, Prentice Hall</i> , New Jersey, United States. |
| 6 | Winterkorn, H. F. and Fang, H. Y. (2018), "Handbook Geotechnical Engineering". <i>Galgotia book source</i> , New Delhi. |
| 7 | Samsher Prakash, (1981), "Soil Dynamics". <i>McGraw-Hill Book Company</i> , New York. |

Reference Books and IS codes:

| | |
|---|--|
| 1 | Bowles, J. E., 1996, "Foundation analysis and design", 5 th edition, The McGraw-Hill Companies, Inc. |
| 2 | Coduto, D. P., 2002, "Geotechnical Engineering principles and practices", Prentice Hall of India private limited, New Delhi. |
| 3 | Das, B. M., 1998, "Principles of geotechnical engineering", PWS series in civil engineering. |
| 4 | Gulhati, S. K. and Datta, M., 2005, "Geotechnical engineering", Tata McGraw-Hill |

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| | Companies. |
| 5 | Han Jie, “Principles and Practice of Ground Improvement” Wiley |
| 6 | Korner; “Designing with Geosynthetics” |
| 7 | Lambe, W. T. and Whitman, R. V., “Soil Mechanics, SI version”, John Wiley, and sons. |
| 8 | BS8006, “Code of practice for Strengthened/reinforced soil and other fills”. |
| 9 | IRC 78 2014, “Standard Specifications and Code of Practice for Road Bridges, Section VII, Foundations and Substructure, (Revised Edition)”. |
| 10 | IS: 1080-1988, "Design and construction of Shallow Foundations in Soils (other than raft, ring, and shell)”. |
| 11 | IS: 1498-1970, "Classification and Identifications of soils for General Engineering Purposes". |
| 12 | IS: 1888-1982, "Method of Load Test on soils". |
| 13 | IS: 1892-1979, "Code of Practice for Subsurface Investigations for Foundations". |
| 14 | IS: 1904-1986, "Design and Construction of Foundations in Soils, General Requirements". |
| 15 | IS:2132-1986, 'Code of Practice for Thin-Walled Tube Sampling of Soils". |
| 16 | IS: 2911-Part I-Sect. 1-1979, "Design and Construction of Pile Foundations-Driven Cast in-situ concrete Piles". |
| 17 | IS: 2911-Part I-Sect. 3-1979, --Design and construction of Pile Foundation-Driven Precast Piles". |
| 18 | IS; 2911-Part 3-1980, "Code of Practice for Design and Construction of Pile Foundation- Under-reamed Piles". |
| 19 | IS: 2911-Part 4-1974, "Load Test on Piles". |
| 20 | IS; 2950 A-I 1974 1 "Code of Practice for Design and Construction of Raft Foundations". |
| 21 | IS: 2974-Part 1-1982, "Foundation for Reciprocating Type Machines". |
| 22 | IS; 2974-Part 2-1980, "Foundation for Impact Type machines (Hammer Foundation)". |
| 23 | IS: 2974-Part 3-1975, "Foundation for Rotary Type machines (Medium and Highway Frequency)". |
| 24 | IS: 2974-Part 4-1979, "Foundations for Rotary Type Machines for Low Frequency". |
| 25 | IS: 2974-Part 5-1970, "Foundations for Impact Type Machines other than Hammers (Forging and Stamping Press, Pig-breaker, Elevator and Hoist Tower). |
| 26 | IS: 3764-1970, "Safety Codes for Excavation work". |
| 27 | IS: 3955-1967, "Code of Practice for Design and Construction of well Foundations". |
| 28 | IS: 4434-1978, "Code of Practice for In-situ vane Shear Test for soils". |
| 29 | IS: 4453-1980, "Code of Practice for Sub-surface Exploration by Pits, Trenches, Drifts and Shafts." |
| 30 | IS: 4968-Part 2-1976, "Dynamic Method using cone and Bentonite Slurry". |
| 31 | IS: 4968-Part 3-1976, "Static cone Penetration Test". |
| 32 | IS 5249 1992 “Design of dynamic properties of soil-Method of tests”. |

| | |
|----|--|
| 33 | IS: 5121-1969, "Safety code for Piling and other Deep Foundations". |
| 34 | IS: 6403-1981, "Code of Practice for Determination of Bearing Capacity of Shallow Foundations". |
| 35 | IS: 8009-Part 1-1976, "Shallow Foundation Subjected to Symmetrical Static Vertical Loads". |
| 36 | IS: 8009-Part 2-1980, "Code of Practice for calculations of settlement of Foundation-Deep Foundation subjected To Symmetrical Static Vertical Loading. |
| 37 | IS 11089-1984, "Code of practice for design and construction of ring foundation". |
| 38 | IS 12070 (1987): Code of practice for design and construction of shallow foundations on rock [CED 48: Rock Mechanics]. |
| 39 | IS 13094-1992 "Selection of ground improvement techniques for foundation in weak soils-Guidelines". |
| 40 | IS 14593-1998 "Design and construction of bored cast-in-situ pile foundation on rocks-Guidelines". |
| 41 | IS 15284: Part 1: 2003 Design and construction for ground improvement-stone column |
| 42 | IS 15284-Part 2-2004 "Design and construction of ground improvement-Guidelines Part 2: Pre-consolidation using vertical drains". |

Semester- I

| Course Code | Course Name | Credits |
|-------------|---|---------|
| STR PE1021 | Analysis and Design of Multi-storey Buildings | 03 |
| | Program Elective -II | |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

Rationale

The basis is study of knowledge of analysis and design of multistoried buildings for static and dynamic loading. The subject involves Building frames, frame-shear wall buildings; Braced Buildings with mathematical modeling. The course contents are earthquake analysis and ductility detailing of frames for seismic forces. The study involves special aspects in Multi-storied buildings like Effect of torsion, flexible first story, P-delta effect, soil-structure interaction and design of fire resistant structure.

Course Objectives

1. To understand the complete analysis and design of building frames using relevant IS codes and mathematical modelling of buildings with different structural systems.
2. To impart knowledge on static and dynamic wind analysis, design of multi-storeyed buildings
3. To impart the knowledge of ductile detailing of earthquake resistant structures.

4. To understand the complete Special aspects in Multi-storeyed buildings.
5. To develop the students well versed with concepts of Analysis and Design of multi-storeyed buildings with masonry infills.
6. To familiarize students with the Indian codes/Standards for static and dynamic wind analysis, as well as fire resistant structures. design and design for Fire Resistant.

Detailed Syllabus

| Module | Course Modules / Contents | Periods |
|-------------|---|----------------|
| I. | Building frames, frame-shear wall buildings; Braced Buildings, Mathematical modelling of buildings with different structural systems with and without diaphragms. | 04 hrs |
| II. | Earthquake, wind and other (i.e. blast and snow) load calculations along with dead load and live loads and their combinations. | 12 hrs. |
| III. | Ductile Detailing of Frames for Seismic Forces: Introduction, General principles, Factors that increase ductility, Specifications of materials for ductility, Ductile detailing of beams – Requirements, Ductile detailing of columns and frame members with axial load (P) and moment (M) – Requirements. Design of shear walls, Joints in frames. | 07 hrs. |
| IV. | Special aspects in Multi-storeyed buildings: Effect of torsion, flexible first story, P-delta effect, soil-structure interaction on building response, drift limitation. | 06 hrs. |
| V | Analysis and Design of multi-storeyed buildings with masonry infills, Sequential analysis for multi-storeyed buildings. | 06 hrs. |
| VI | Design for Fire Resistant, Creep, Shrinkage and Thermal stresses. | 04 hrs. |

Contribution to Outcomes

On successful completion of the course, the candidate shall be able

1. To develop mathematical model, perform analysis and design Reinforced Concrete buildings
2. To present methods of static and dynamic wind analysis of multistoried buildings.
3. To present the knowledge of ductile detailing of earthquake resistant structures.
4. To design multi-storeyed buildings by relevant Indian Codes/Standards for RCC structures and special aspects in Multi-storeyed buildings.
5. To analyze and Design of multi-storeyed buildings with masonry infills.
6. To design the Fire-Resistant structures.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Farzad Naeim (2001): 'Handbook on Seismic Analysis and Design of Structures', *Kluwer Academic Publisher*
2. Paulay, T. and Prestiley, M.J.N. (1999): 'Seismic Design of R.C.C.and Masonry Buildings', *John Willey and Sons (2nd Edition)*
3. Booth, E. (1994): 'Concrete Structures in Earthquake Regions', *Longman Higher Education*
4. Park, R. and Paulay, T. (1975): 'Reinforced Concrete Structures', *John Willey and Sons (2nd Edition)*
5. Fintel, M. (1986): 'Handbook of Concrete Engineering', *CBS Publishers, Delhi (2nd Edition)*
- 6 Pankaj Agqrwal and Manish Shrikhande : " Earthquqke Resistant Design of Structures " Prentice- Hall of India Private limited New Delhi
- 7 S.K.Duggal "Earthquake Resistant Design of Structures " Oxford

| Semester I | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRPE1022 | Advanced Design of Concrete Structures | 03 |
| | Program Elective-II | |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|-------------|-------------|--------------------|--------------------------------|-----------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test -I | Test- II | Aver age | | | | | | |
| 20 | 20 | 20 | | | | | | |
| | | | 80 | 03 | - | - | - | 100 |

| Rationale |
|-----------|
|-----------|

Reinforced concrete construction is widely used for residential, commercial and industrial structures., Students will learn advanced topics related to the behaviour and design of reinforced concrete. This advance topic includes Ultimate Load Analysis of RC slabs by using Yield line theory, Design of flat plate and flat slab, Design of Portal Frame, Design of combined footing, Raft foundation, Pile foundation including pile cap, Design of Silos and Bunkers, Analysis and design of beams curved in plans, Design of structures like Folded plate roofs, Arched Slab System, Deep beams, Corbels, Nibs etc.

| Course Objectives |
|-------------------|
|-------------------|

1. To understand the design philosophy of two-way slab using ultimate load method.
2. To study the concept of the design of flat slab, flat plate slab.
3. To study design of portal frame and special types of foundations such as raft foundations and pile foundations including pile cap.
4. To understand the design concept for bunkers and silos.
5. To study the analysis of the beams curved in plan and extend its application for the design of such beams.
6. To understand the concept for the design of structures like folded plate roofs, arched slab system, deep beams corbels, nibs etc.

| Detailed Syllabus | | |
|--------------------------|---|----------------------|
| Module | Course Modules / Contents | Contact Hours |
| I | Yield line theory | 06 hrs |
| | Ultimate Load Analysis of RC slabs using Yield line theory (Virtual work and equilibrium method); Application for the analysis and design to orthotopically reinforced square/rectangular slabs with various boundary conditions under uniformly distributed loads. | |
| II | Design of flat slabs | 05 hrs |
| | Behaviour of flat slab, Method of analysis (Direct design method, Equivalent frame method, Transfer of moments of column), Shear in flat plates and flat slabs, Design of flat plate and flat slab. | |
| III | Design of Portal Frame and Special Foundations | 08 hrs |
| | Design of Portal Frame using LSM. Special Foundations: Design of combined footing, Raft foundation, Pile foundation including pile cap. | |
| IV | Design of Silos and Bunkers | 07 hrs |
| | Lateral pressure as per Janssen's and Airy's theory, Design consideration for square, rectangular and circular shapes, Design of Hopper and Support structures. | |
| V | Analysis and design of beams curved in plans | 05 hrs |
| | Beams curved in plans loaded perpendicular to their plane, Fixed and continuous curved beams, design of beams curved in plan. | |
| VI | Design of miscellaneous structures | 08 hrs |
| | Folded plate roofs, Arched Slab System. Deep beams - 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. | |

| |
|--------------------------------|
| Contribution to Outcome |
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On successful completion of the course, the candidate will be able to:

1. Design philosophy of two-way slab using ultimate load method.
2. Understand the concept of the design of flat slab, flat plate slab.

3. Design the portal frame and special types of foundations such as raft foundations and pile foundations including pile cap.
4. Understand the design concept for bunkers and silos.
5. Analyze of the beams curved in plan and extend its application for the design of such beams.
6. Understand the concept for the design of structures like folded plate roofs, arched slab system, deep beams corbels, nibs etc.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

5. Question paper will comprise of **six** questions; each carrying 20 marks.
6. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
7. The students will have to attempt any **four** questions out of **total six** questions.
8. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. V. Ramakrishnan and P.D. Arthur: 'Ultimate Strength design for structural concrete', Wheeler Publishing Co.
2. S.R. Karve and V.L. Shah: 'Design of reinforced cement concrete structures using Limit State Approach', Structures Publishers.
3. 3. O.P. Jain and Jaikrishna: 'Plain and reinforced concrete (Vol-II)'; Nemchand and Bros., Roorkee.
4. S. Ramamrutham : 'Design of reinforced Concrete Structures', Dhanpat Rai Publishing Co., New Delhi
5. P. C. Varghese: 'Design of Reinforced concrete Foundations', PHI Learning Pvt. Ltd., New Delhi
6. P. C. Varghese: 'Advanced Reinforced Concrete Design', PHI Learning Pvt. Ltd., New Delhi
7. Ramachandra: 'Design of Concrete Structures (Vol. I and II), Standard Book House. New Delhi
8. N.C. Sinha and S.K. Roy: 'Fundamentals of Reinforced Concrete'; S. Chand Publications, New Delhi
9. B.C. Punimia, Ahok Kumar Jain and Arun Kumar Jain: 'Reinforced Cement Concrete Designs'; Laxmi Publishers, New Delhi
10. N. Subramanian: 'Design of Reinforced Concrete Structures'; Oxford University Press
11. K. Krishna Raju: 'Advanced Reinforced Concrete Design'; CBS Publishers and Distributors, New Delhi
12. S.S. Bhavikatti: 'Advanced RCC Design (Vol. II)'; New Age Publishers, New Delhi.

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|-------------------|
| Semester I |
|-------------------|

| Course Code | Course Name | Credits |
|-------------|---|---------|
| STRPE1023 | Program Elective-II:Ground Improvement Techniques | 03 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------------|--------------------------------|-----------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 3 | - | - | - | 100 |

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| Rationale |
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With the tremendous infrastructural development taking place all over the world it becomes necessary for the learners to be exposed to various problems associated with soil deposits and methods to evaluate them. The learners should be aware of the methods to improve the characteristics of difficult soils.

| |
|--------------------------|
| Course Objectives |
|--------------------------|

1. Understanding the engineering behaviour of various natural and manmade soil deposits
2. Explains the concept of various ground improvement techniques and the types of compactions and its effect on soil properties
3. Explains the types of drains and various stabilization techniques
4. Informs about the types of reinforcement and design principles, grouting techniques
5. Introduction of various type of geotextiles and their functions

| Detailed Syllabus | | | |
|-------------------|---|--|---------------|
| Module | Course Module / Contents | | Contact hours |
| 1 | Introduction to Ground improvement techniques | | 11 |
| | 1.1 | Rock cycle, classification of rocks and rock forming minerals. Weathering process and formation of soil. Engineering properties of the soft, weak and manmade deposits, Role of ground improvement in foundation engineering | |
| | 1.2 | Methods of dewatering and pressure relief-deep well drainage vacuum dewatering systems | |
| | 1.3 | Drainage and Dewatering - drainage by electroosmosis – analysis and design of dewatering systems – installation and operation of dewatering systems well point system, shallow & deep well system, vacuum dewatering, electro osmosis | |
| 2 | In-situ densification methods in granular soils | | 10 |
| | 2.1 | Introduction-mechanical stabilization-deep dynamic compaction-vibro compaction- blasting. In-situ densification methods in cohesive soils | |
| | 2.2 | Preloading- Concept of three-dimensional consolidation – sand drain design and methods of their installation – fabric drains-stone columns & lime piles (installation techniques only) Cement and lime stabilization | |
| | 2.3 | Cement stabilization-types of soil cement-factors affecting soil cement mixing, Lime stabilization effect of lime on soil properties | |
| 3 | Introduction to grouts and grouting | | 9 |
| | 3.1 | Basic functions –permeation grouting, compaction grouting, hydro fracturing- -Grout ability Ratio - Classification of grouts | |
| | 3.2 | Suspension grouts –cement grouts –admixtures used & their role – bentonites grouts –cement and bentonite grouts – lime grouts – asphaltic emulsion grouts – Solution grouts – aqueous solution - non-aqueous solutions – colloidal solutions – advantages and disadvantages of solution grouts over suspension grouts. | |
| | 3.3 | Properties of grouts: viscosity, fluidity, stability, rigidity, thixotropy, Applications of grouting | |
| 4 | Earth Reinforcement | | 9 |
| | 4.1 | Concept of reinforced earth –load transfer mechanism and strength development | |
| | 4.2 | Stability analysis of reinforced earth retaining walls-external stability analysis, internal stability analysis (brief mention about the methods only) - application areas. | |
| | 4.3 | Geosynthetics: Classification- Functions of geotextiles as separators, reinforcement, filters and in drainage-damage and durability of geotextiles. | |

Contribution to Outcomes

On completion of this course, the learner will be able to:

1. Remember various ground improvement techniques
2. Identify the problems associated with the existing ground condition
3. Select different stabilization process of soil using lime, fly ash etc
4. Remember principles and methods of grouting techniques
5. Understand various types of geosynthetics and its applications

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

- 1 Shashi.K.Gulhati& Manoj Datta –Geotechnical Engineering , Tata McGraw Hill
- 2 G. L. Sivakumar, G. L. Babu, Soil Reinforcement and Geosynthetics, University Press
- 3 Shroff AV and Shah. D.L –Grouting technology in tunneling and Dam construction, Oxford and IBH
- 4 PurushothamaRaj.P – Ground Improvement techniques, Laxmi Publications(P) Ltd., New Delhi
- 5 Shashi.K.Gulhati& Manoj Datta –Geotechnical Engineering , Tata McGraw Hill

Reference Books:

- 1 Robert M. Koerner – “Designing with Geosynthetics”, Prentice Hall Mc Graw Hill
- 2 C.J.F.P Jones - Earth Reinforcement and soil structures, Buuterworths
- 3 Robert M. Koerner - Construction and Geotechnical Methods in Foundation Engineering, Mc Graw Hill

| |
|-------------------|
| Semester I |
|-------------------|

| Course Code | Course Name | Credits |
|-------------|-------------------------------|---------|
| STRPE1024 | Advanced Structural Mechanics | 03 |
| | Program Elective-II | |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|-------------|-------------|--------------------|--------------------------------|-----------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test -I | Test- II | Aver age | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

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| Rationale |
|------------------|

The preparation for this course should cover the subjects of statics and dynamics of particles and rigid bodies, mechanics of deformable solids, structural analysis, mechanical vibrations and elementary structural dynamics, as they normally taught to UG courses in Civil or Mechanical engineering.

| |
|-------------------|
| Objectives |
|-------------------|

This course is concerned with the development of analytical methods for solving problems in mechanics of materials that are generally considered beyond the scope of basic course in the discipline. As such, the developments tend to evolve from fundamentals principles such as equilibrium and conservation of energy.

| Detailed Syllabus | | |
|-------------------|---|-------|
| Module | Course Modules / Contents | Hours |
| 1 | Unsymmetrical bending, flexural stresses due to bending in two planes, shear center, bending of unsymmetrical section. | 6 |
| 2 | Bending of beams with large initial curvature. Application of analysis of hooks, bends and curved links, etc | 7 |
| 3 | Beams curved in plans loaded perpendicular to there plane, Fixed and continuous curved beams | 6 |
| 4 | Theories of failure, Max stress theory, max shear stress theory, max strain theory, Von Mises & Trescas failure theories. | 6 |
| 5 | Beams on Elastic foundation, Beams of unlimited length, Semi-infinite lengths and finite lengths on elastic foundation. | 6 |
| 6 | Analysis of deep beams, determination of stresses and deflection | 6 |

| |
|--------------------------------|
| Contribution to Outcome |
|--------------------------------|

On successful completion of the course, the learner will be able to:

1. Apply stiffness method of analysis for beams, frames and grids structural elements.
2. Apply structural mechanics principles to unsymmetrical and open-thin walled cross sections
3. Apply structural mechanics principals to beams curved in plan and beams curved in elevation and for deep beams
4. Apply structural mechanics principles to beams resting on elastic foundations.
5. Use different theories of failure for structural analysis and design.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination: Question paper will comprise of **six** questions; each carrying 20 marks. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics. The students will have to attempt any **four** questions out of **total six** questions. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Wang, “Applied Elasticity”, McGraw hill book Co.
2. Timoshenko, “Theory of Elasticity”, McGraw hill book Co.
3. J. Chakrabarti, “Theory of Plasticity”, McGraw hill book Co.
4. Timoshenko S., “Strength of Materials Vol – I & II”, CBS Publishers
5. Shames I. H., “Mechanics of Deformable Solids”, Prentice Hall India
6. Boresi A. P., “Advanced Mechanics of Material”, John Wiley & Sons.
7. Srinath L. S., “Advanced Mechanics of Solids”, Tata McGraw Hill

| Semester I | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRIE1011 | Institute Level Elective: Product Lifecycle Management | 03 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Termwork/Practical/Oral | | | Total Marks |
|---------------------|-------|---------|--------------|--------------------------|-------------------------|----|----|-------------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

| Module | Detailed Contents | Hrs |
|-----------|---|-----|
| I | Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM | 10 |
| II | Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design | 09 |

| | | |
|------------|---|----|
| | forXSystem,ObjectivePropertiesandDesignforX Tools,Choice ofDesignforX ToolsandTheir Usein theDesignProcess | |
| III | ProductDataManagement(PDM): Product and Product Data, PDM systems and importance, Components of PDM,ReasonforimplementingaPDMsystem,financial justificationofPDM,barriersto PDMimplementation | 05 |
| IV | VirtualProductDevelopmentTools: Forcomponents,machines,andmanufacturingplants,3DCADsystemsandrealisticrende ringtechniques,Digitalmock-up,Modelbuilding,Modelanalysis, Modelingand simulationsin ProductDesign, Examples/Casestudies | 05 |
| V | IntegrationofEnvironmentalAspectsin ProductDesign: SustainableDevelopment,DesignforEnvironment,NeedforLifeCycleEnvironmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies,IntroductionofEnvironmentalStrategiesintotheDesignProcess,LifeCycle EnvironmentalStrategies andConsiderationsforProductDesign | 05 |
| VI | LifeCycleAssessment andLifeCycleCost Analysis: Properties,andFrameworkofLifeCycleAssessment,PhasesofLCAinISOStandards, Fields of Application and Limitations of Life Cycle Assessment, CostAnalysis and the Life Cycle Approach, General Framework for LCCA, Evolution ofModelsforProductLife Cycle CostAnalysis | 05 |

ContributiontoOutcomes:

Studentswillbeable t

- GainknowledgeaboutphasesofPLM,PLMstrategiesandmethodologyforPLMfeasibilitystudyandPDM implementation.
- Illustratevariousapproachesandtechniques fordesigninganddevelopingproducts.
- Applyproductengineeringguidelines/thumbrulesindesigningproductsformoulding,machining,sheetmetal workingetc.
- Acquireknowledgeinapplyingvirtualproductdevelopmenttoolsforcomponents,machiningandmanufacturingpl ant

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstestandtheotheriseitheraclasstest or assignment on liveproblems or course project.

EndSemesterTheoryExamination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in questionpapers of end semester examination. **In question paper weightage of each module will be proportional tonumberofrespectivelecturehours asmentionin thesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestion carryequalmarks
3. Questionswillbemixedinnature(forexamplesupposedQ.2haspart(a)frommodule3thenpart

(b)will befrom anymodule other than module3)

4. OnlyFour question needtobe solved.

References:

1. JohnStark, "ProductLifecycleManagement:Paradigmfor21stCenturyProductRealisation", Springer-Verlag,2004. ISBN:1852338105
2. FabioGiudice,GuidoLaRosa,AntoninoRisitano,"ProductDesignfortheenvironment-Alifecycle approach",Taylor&Francis2006,ISBN:0849327229
3. SaaksvuoriAntti,ImmonenAnselmie,"ProductLifeCycleManagement",Springer,Dreamtech, ISBN:3540257314
4. MichaelGrieve,"ProductLifecycleManagement:Drivingthenextgenerationofleanthinking", TataMcGrawHill,2006,ISBN:0070636265

| SemesterI | | |
|------------|--|---------|
| CourseCode | CourseName | Credits |
| STRIE1012 | InstituteLevelElective: ReliabilityEngineering | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|-------------|--------------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End SemEx am | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Averag e | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

| Module | DetailedContents | Hrs |
|--------|--|-----|
| I | Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis. | 08 |
| II | Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis. | 08 |
| III | System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems. | 05 |
| IV | Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method. | 08 |

| | | |
|-----------|--|----|
| V | Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability—qualitative aspects. | 05 |
| VI | Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis | 05 |

Outcomes

Students will be able to...

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

| SemesterI | | |
|------------|--|---------|
| CourseCode | CourseName | Credits |
| STRIE1013 | InstituteLevelElective:ManagementInformationSystem | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End SemEx am | Durationof End SemExam | TW | PR | OR | |
| Test 1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- Thecourseisblendof ManagementandTechnicalfield.
- Discusstherolesplayedbyinformationtechnologyintoday'sbusinessanddefinevarious technologyarchitecturesonwhichinformationsystemsarebuilt
- Defineandanalyzetypicalfunctionalinformationsystemsandidentifyhowtheymeettheneedsofthe firm to deliverefficiencyandcompetitive advantage
- Identifythebasicsteps insystemsdevelopment

| Module | DetailedContents | Hrs |
|--------|--|-----|
| I | IntroductionToInformationSystems(IS):ComputerBasedInformationSystems,ImpactofITonorganizations,ImportanceofISToSociety.OrganizationalStrategy, CompetitiveAdvantages andIS. | 4 |
| II | DataandKnowledgeManagement:DatabaseApproach,BigData,DatawarehouseandData Marts, KnowledgeManagement. Businessintelligence(BI):ManagersandDecisionMaking,BIforDataanalysisand PresentingResults | 7 |
| III | EthicalissuesandPrivacy:InformationSecurity.Threatto IS,andSecurityControls | 7 |
| IV | SocialComputing(SC):Web2.0and3.0,SCinbusiness-shopping,Marketing, OperationalandAnalyticCRM,E-businessandE-commerce–B2BB2C.Mobilecommerce. | 7 |
| V | ComputerNetworksWiredandWirelesstechnology,Pervasivecomputing,Cloud computingmodel. | 6 |
| VI | InformationSystemwithinOrganization:TransactionProcessingSystems,FunctionalArea Information System,ERP andERPsupportof Business Process. AcquiringInformationSystemsandApplications:VariousSystemdevelopmentlife cyclemodels. | 8 |

Contribution to Outcomes

Students will be able to:

- Explain how information systems transform business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only four questions need to be solved.

References:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

| Semester I | | |
|-------------|---|---------|
| Course Code | Course Name | Credits |
| STRIE1014 | Institute Level Elective: Design of Experiments | 03 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|----------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | EndSem Exam | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

| Module | Detailed Contents | Hrs |
|------------|---|-----|
| I | Introduction 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology | 06 |
| II | Fitting Regression Models 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit | 08 |
| III | Two-Level Factorial Designs 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs | 07 |

| | | |
|-----------|---|----|
| | | |
| IV | Two-Level Fractional Factorial Designs 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs | 07 |
| V | Response Surface Methods and Designs 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces | 07 |
| VI | Taguchi Approach 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples | 04 |

Contribution to Outcomes

Students will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only four questions need to be solved.

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George EP Box, J Stuart Hunter, William GH Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. WJ Dimond, Peactical Experiment Designs for Engineers and Scientists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D.T. Voss

| Semester I | | |
|------------|---|---------|
| CourseCode | CourseName | Credits |
| STRIE1015 | InstituteLevelElective: OperationResearch | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End SemEx am | Durationof End SemExam | TW | PR | OR | |
| Test 1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- Formulateareal-worldproblem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.

| Module | DetailedContents | Hrs |
|--------|--|-----|
| I | <p>Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research</p> <p>Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis</p> <p>Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.</p> <p>Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem</p> <p>Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.</p> | 14 |

| | | |
|------------|---|----|
| II | Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population | 05 |
| III | Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation | 05 |
| IV | Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management, employment smoothing, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems. | 05 |
| V | Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games. | 05 |
| VI | Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, | 05 |

Outcomes:

Students will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four questions need to be solved.

References:

1. Taha, H.A. "Operations Research-An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Wiley and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.
5. Operations Research, Kanti Swarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

| SemesterI | | |
|------------|---|---------|
| CourseCode | CourseName | Credits |
| STRIE1016 | InstituteLevel Elective: CyberSecurityandLaws | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------|------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End Sem Exam | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To understand and identify different types of cybercrime and cyberlaw
- To recognize Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

| Module | DetailedContents | Hrs |
|--------|---|-----|
| I | Introduction to Cybercrime: Cybercrime definition and origin of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian IT Act 2000, A global perspective on cybercrimes. | 4 |
| II | Cyber offenses & Cybercrime: How criminals plan the attacks, Social Engg, Cyberstalking, Cybercaf  and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Fraudsin Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops | 9 |
| III | Tools and Methods Used in Cyberline Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attack on Wireless Networks, Phishing, Identity Theft (ID Theft) | 6 |
| IV | The Concept of Cyberspace E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law | 8 |

| | | |
|----|---|---|
| V | IndianITAct. CyberCrime andCriminal Justice:Penalties,AdjudicationandAppealsUndertheITAct,2000,IT Act. 2008and its Amendments | 6 |
| VI | InformationSecurityStandardcompliances SOX,GLBA,HIPAA, ISO,FISMA,NERC,PCI. | 6 |

Outcomes

Studentswill beable to:

- Understandthe conceptofcybercrimeand itseffectonoutsideworld
- Interpret andapplyITlawinvariouslegalissues
- Distinguishdifferentaspectsof cyberlaw
- ApplyInformation SecurityStandards complianceduringsoftware designand development

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstestandtheotheriseitheraclasstest or assignment on live problems or course project.

EndSemesterTheoryExamination:

Someguidelinesforsettingupthequestionpaper.Minimum80%syllabusshouldbecoveredinquestionpapersof end semester examination.

Inquestionpaperweightageofeachmodulewillbeproportionaltonumberofrespectivelect urehoursas mention in thesyllabus.

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestion carryequalmarks
3. Questionswillbemixedinnature(forexamplesupposedQ.2haspart(a)frommodule3thenpart (b)will befrom anymodule otherthan module3)
4. OnlyFour questionneedto besolved.

References:

1. NinaGodbole,SunitBelapure, CyberSecurity,WileyIndia, New Delhi
2. TheIndianCyberLawbySureshT. Vishwanathan;BharatLawHouseNewDelhi
3. TheInformationtechnologyAct,2000;BareAct- ProfessionalBookPublishers,New Delhi.
4. Cyber Law &CyberCrimesByAdvocatePrashantMali;SnowWhitePublications,Mumbai
5. NinaGodbole,InformationSystemsSecurity, WileyIndia,NewDelhi
6. KennethJ.Knapp,CyberSecurity&GlobalInformationAssuranceInformationSciencePublishing.
7. WilliamStallings,CryptographyandNetworkSecurity,PearsonPublication
8. Websitesformoreinformationis available on: TheInformation TechnologyACT,2008-TIFR :<https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional:<https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

| SemesterI | | |
|------------|---|---------|
| CourseCode | CourseName | Credits |
| STRIE1017 | InstituteLevelElective: DisasterManagement andMitigation Measures | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------|------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End Sem Exam | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome / minimize it.
- To understand role of individual and various organizations during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

| Module | DetailedContents | Hrs |
|--------|---|-----|
| I | Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change. | 03 |
| II | Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloudburst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters. | 09 |

| | | |
|-------------------|--|------------------|
| <p>III</p> | <p>Disaster Management, Policy and Administration</p> <p>3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.</p> <p>3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of disaster management, rescue operations-how to start with and</p> | <p>06</p> |
|-------------------|--|------------------|

| | | |
|-----------|--|-----------|
| | how to proceed in due course of time, study of flow chart showing the entire process. | |
| IV | Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication among different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Application of GIS, Remote sensing and GPS in this regard. | 06 |
| V | Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events. | 09 |
| VI | Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids. | 06 |

Outcomes:

Students will be able to...

- Get to know natural as well as man-made disaster and their extent and possible effect on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

References:

1. 'Disaster Management' by Harsh K. Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation' – RBSingh, Rawat Publications
7. Concepts and Techniques of GIS – C.P. Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

| SemesterI | | |
|------------|---|---------|
| CourseCode | CourseName | Credits |
| STRIE1018 | InstituteLevelElective:EnergyAuditandManagement | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------|------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End Sem Exam | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

| Module | DetailedContents | Hrs |
|--------|---|-----|
| I | EnergyScenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance | 04 |
| II | Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach- understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR) | 08 |
| III | Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives. | 10 |

| | | |
|-----------|--|----|
| IV | Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation-types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities. | 10 |
| V | Energy Performance Assessment: Onsite Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis. | 04 |
| VI | Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED Rating, Application of Non-Conventional and Renewable Energy Sources | 03 |

Outcomes:

Students will be able to:

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.
- To analyze the data collected during performance evaluation and recommend energy saving measures.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons

4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B. Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W.J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

| Semester I | | |
|-------------------|---|-----------|
| Course Code | Course Name | Credits |
| STRIE 1019 | Institute Level Optional Course I: Development Engineering | 03 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theor y | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term work / Practical / Oral | | | Total Marks |
|---------------------|--------|-----|--------------|--------------------------|------------------------------|----|----|-------------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Avg | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

| Module | Detailed Contents | Hrs. |
|------------|--|-----------|
| I | Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services. | 08 |
| II | Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development. | 04 |
| III | Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development. | 06 |

| | | |
|-----------|---|-----------|
| IV | Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments. | 04 |
| V | Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom. | 10 |
| VI | Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education | 04 |

Outcomes: Learner will be able to...

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. **Only Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.

8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp.123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 –407

| Semester I | | |
|-------------|---------------|---------|
| Course Code | Course Name | Credits |
| STRL101 | Program Lab-I | 01 |

| Teaching Scheme | | | | | | |
|-----------------|-----------|----------|------------------|-----------|----------|-------|
| Contact Hours | | | Credits Assigned | | | |
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 2 | - | - | 1 | - | 01 |

| Evaluation Scheme | | | | | | | | |
|---------------------|--------|---------|--------------|--------------------------|---------------------------|----|----|-------|
| Theory | | | | | Term Work/ Practical/Oral | | | Total |
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| - | - | - | - | - | 25 | - | 25 | 50 |

| Objectives: | |
|---|--|
| <ul style="list-style-type: none"> To impart knowledge of smart materials. Perform statistical quality analysis To illustrate principles of structural health monitoring. To provide quantitative means to assess the structural integrity loss a system undergoes after natural disasters and other hazardous events. To understand the physics of the problem To be familiar with hands on practice. | |

| Detailed Syllabus | | |
|-------------------|---|-----|
| Module | Course Module / Contents | Hrs |
| I | Reinforcement Detailing: Minimum two site visits to ongoing Major construction sites (High rise building/ Bridge/ Offshore structure etc.) to study the reinforcement detailing and use of special/ advanced construction techniques /equipment associated with ongoing major construction works. Visit Report to be submitted in written form | 10 |
| II | Structural audit: Students will be asked to work upon minimum two of the following topics during the semester. They will submit the report of each topic containing the information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic. Visit the existing old bridge and prepare a detailed condition assessment report. Visit the existing old RC building and prepare a detailed condition assessment report. Identify structural deficiencies and suggest suitable retrofitting strategies. Laboratory testing of various retrofitted elements like column, beam, slab and joints under the action of flexure, shear and axial loading. | 10 |
| VI | ONE assignment on each subject. | - |

Contribution to Outcomes

Students will be able to:

- Observe very keenly various activities/processes going on at various construction sites and hence comment on how consistently they are performed and hence suggest improvement measures
- Write effective project reports highlighting the pros & cons of the technologies envisaged for the project.
- Perform on-field tests to check the quality of materials/ technology used and hence draw inferences from the results thus obtained
- Demonstrate effective interpersonal soft skills w.r.t putting forwards one's viewpoint, group discussion, etc.

| Semester I | | |
|-------------|-------------------|---------|
| Course Code | Course Name | Credits |
| STRSBL101 | Skill Based Lab-I | 02 |

| Teaching Scheme | | | | | | |
|-----------------|-----------|----------|------------------|-----------|----------|-------|
| Contact Hours | | | Credits Assigned | | | |
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 4 | - | - | 2 | - | 02 |

| Evaluation Scheme | | | | | | | | |
|---------------------|--------|---------|--------------|--------------------------|---------------------------|----|----|-------|
| Theory | | | | | Term Work/ Practical/Oral | | | Total |
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| - | - | - | - | - | 50 | - | 50 | 100 |

| Objectives | |
|---|--|
| <ul style="list-style-type: none"> ● Use listening, speaking, reading and writing skills for communication purposes and attempt tasks by using functional grammar and vocabulary effectively ● To make students aware about the difference between listening and hearing ● To enhance speaking and technical writingskills. ● To prepare students to face interviews, groupdiscussions. ● Produce effective dialogue for business related situations | |

| Detailed Syllabus | | |
|-------------------|--|-----|
| Module | Course Module / Contents | Hrs |
| I | Listening Skills: Barriers to listening, Kinds of Listening & Note making. | 03 |
| II | Speaking Skills: Voice Modulation, Good Pronunciation, Speaking without fear, Extempore & Prepared speaking, Body Language, Telephone Etiquette/ Mobile /Video conferences. | 04 |
| III | Reading Skills: SQ3R Reading Technique, Skimming and Scanning | 04 |
| IV | Defining the Features of Technical Writing Principles and Strategies of Technical Report, Knowing Your Audience, Purpose and Length of Report. Writing clear sentences and paragraphs. Remove jargon, redundancy and wordiness | 08 |
| V | Presentation Skills: Planning, preparing, Organizing, Delivery, Feedback. Punching Up the Presentation Kinds of graphics and their messages, Suitability for placement in a graphic representation, Group Practice and Interactive Session, spotting common language problems (lengthy and confusing sentence structures, weak vocabulary, etc), Editing Content, Logic and Language, Guided writing practice with examples | 10 |

| | | |
|-----------|---|-----------|
| VI | Interview: Pre-Interview Preparation, Interview Question Answer, Resume & Job Application, Group Discussion, Telephone Interviews. | 08 |
|-----------|---|-----------|

Contribution to Outcomes

Students will be able to:

- Differentiate between listening and hearing
- Analyze critically different concepts / principles of communication skills
- Develop speaking and technical writing skills
- Execute interviews, group discussions and presentation skill
- Demonstrate productive skills and have a knack for structured conversations
- Appreciate, analyze, evaluate business reports and research papers
- Summarize technical articles and write technical papers in reputed journals

Reference Books

1. Effective Technical Communication- M. Ashraf Rizvi (Tata McGrawHill)
2. HBR Guide to Better Business Writing- Bryan A. Garner (Harvard Business)
3. Shirley Taylor, "Model Business Letters, Emails and Other Business Documents" (seventh edition), Prentice Hall.
4. Thomas Huckin, Leslie Olsen "Technical writing and Professional Communications for Nonnative speakers of English", McGraw Hill
5. Raman Sharma, "Technical Communication", Oxford University Press 2
6. Raymond Murphy "Essential English Grammar" (Elementary & Intermediate) Cambridge University Press 3
7. Mark Hancock "English Pronunciation in Use" Cambridge University Press
8. NPTEL: Humanities and Social Sciences - NOC: Interpersonal Skills 2 Mod-10 Lec-01 Oral Presentation Lecture-01 – YouTube

Semester II

| |
|---------------------|
| Semester- II |
|---------------------|

| Course Code | Course Name | Credits |
|----------------|------------------------------|-----------|
| STRC201 | FiniteElementAnalysis | 03 |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-----------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

| Theory | | | | | Term Work/Practical/Or al | | | Total |
|---------------------|---------|----------|--------------|--------------------------|---------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test -I | Test-II | Aver age | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

| |
|------------------|
| Rationale |
|------------------|

Finite Element analysis is a numerical technique for solving differential equations that describe many engineering problems. Main reason for its popularity is that the method results in computer codes which are versatile in nature that can solve many practical problems with minimum training. This course of finite element analysis covers the fundamental concept and is designed for students in civil engineering, researchers and design engineers in the structural engineering field. The course presents the FEM as a tool to find approximate solution of differential equations and thus can be used by students. Applications include analysis of structural frameworks, stress analysis etc.

| |
|--------------------------|
| Course Objectives |
|--------------------------|

1. To understand the basics, advantages and significance of finite element analysis.
2. To study the various methods used in finite element formulation.
3. To compute stresses and strains in simple structural elements using finite element methods.
4. To understand geometric non-linearity, material non-linearity in two dimensional elements and general formulation of a physically non-linear problem.
5. To understand the consistent mass matrix and assembly of Mass Matrices- formulation of Physically Non-linear Problems.
6. To understand the formulation and solution of Problems in Structural Mechanics.

Detailed Syllabus

| Module | Course Modules / Contents | Hrs. |
|------------|---|---------------|
| I | Introduction | 06 hrs |
| | Review of Variation methods, Calculus of variation, Variational Principles of solid Mechanics. Principle of Minimum Potential Energy, Principal of Complementary Energy Hamilton Principal, The Basic component- Concept of an element- Various Element Shapes- Displacement models- Formulation of Finite Element Method. Using principle of virtual Displacement- Derivation of Element Stiffness and loads for Pin Jointed Bar element, Beam element, Triangular Plate element (In-plane forces), Triangular and Rectangular Plate Element in Bending. | |
| II | Variational formulation of finite element methods | 07 hrs |
| | Variational Formulation of Finite Element Method (FEM), Isoparametric element- Local vs. Natural Coordinate system, Line, Triangular, Quadrilateral and Tetrahedral Element - Interpolation Displacement Models Formulation of Isoparametric Finite element matrices in Local and Global Coordinate system. | |
| III | General steps involved in finite element analysis | 07 hrs |
| | Implementation of FEM – Discretization of the Structure- Calculation of Element Stiffness, Mass and Equivalent Nodal loads, Assemblage of Structures Matrices, Boundary Conditions- Solution of the overall problem. Calculations of Element Stresses, Computer Program Organization. | |
| IV | Non-Linear analysis using finite element methods | 07 hrs |
| | Introduction to Non-Linear Analysis- Geometric Non-Linearity- Geometric Stiffness of an Axial Element, Stability of Bar Spring System. General Formulation of a Geometrically Non-linear problem. Geometric Stiffness of a Beam-Column of Triangular element. Non-linear material behavior. Non-linear spring- Elastic Plastic Analysis by FEM- Elasto-Plastic Analysis of Truss- Two- Dimensional Element Formulations- | |

| | | |
|----|---|--------|
| | General Formulation of a Physically Non-linear Problem. | |
| V | Dynamic analysis | 06 hrs |
| | Introduction to Dynamic Analysis by FEM- Formulation of Inertial Properties- Lumped Mass vs. Consistent Mass matrices- Condensation and Assembly of Mass Matrices- Formulation of a Physically Non-linear Problems. | |
| VI | Module Name- Application of finite element methods in structural mechanics | 06 hrs |
| | Formulation and solution of Problems in Structural Mechanics using the above methods. | |

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand the basics, advantages and significance of finite element analysis.
2. Study the various methods used in finite element formulation.
3. Compute stresses and strains in simple structural elements using finite element methods.
4. Understand geometric non-linearity, material non-linearity in two dimensional elements and general formulation of a physically non-linear problem.
5. Understand the consistent mass matrix and assembly of Mass Matrices- Formulation of Physically Non-linear Problems.
6. Understand the formulation and solution of Problems in Structural Mechanics.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of six questions; each carrying 20 marks.
2. There can be an internal choice in various sub-questions/questions in order to accommodate the questions on all the topics/ sub-topics.

3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Zienkiewicz, O.C.: 'The Finite Element Method in Engineering Science', *McGraw Hill Book Co.*
2. J.N.Reddy : 'Finite Element Analysis', *McGraw Hill Book Co.*
3. Chandragupta, T.R. and Belagundu, A.D.: 'Introduction to Finite Elements in Engineering', *Prentice Hall of India Pvt. Ltd.*
4. Rajshekaran, S.: 'Finite Element Analysis', *Wheeler Publishing.*
5. Krishnamoorthy, C.S.: 'Finite Element Analysis', *McGraw Hill Book Co.*
6. Cook, R.D., Malkus, D.S. and Plesha, M.E.: 'Concepts and Applications of Finite Element Analysis', *John Wiley and Sons (Asia) Pvt. Ltd.*
7. Bickford, W.B.: 'A First Course in Finite Element Method', *IRWIN, Homewood, IL 60430*
8. Rao, S.S.: 'The Finite Element Method in Engineering', *Pergamon Press.*
9. Weaver, W. and Johnston, P.R.: 'Finite Element for Structural Analysis', *Prentice Hall.*
10. M. Asghar Bhatti, "Fundamental Finite Element Analysis and Applications with Mathematical and MATLAB Computations", *Wiley India Pvt. Ltd.*
11. Chandrupatla and Belegundu, "Introduction to Finite Elements in Engineering" *PHI / Pearson Education, 2003.*
12. Logan. D.L. "A first course in Finite Element Method", *Thomson Asia Pvt. Ltd., 2002.*
13. S.S.Bhavikatti "Finite Element Analysis" New Age International Publication.
14. Y. M. Desai "Finite Element Method" Pearson

| |
|--------------------|
| Semester II |
|--------------------|

| Course Code | Course Name | Credits |
|----------------|------------------------------------|-----------|
| STRC202 | Theory of Plates and Shells | 03 |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-----------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hours | - | - | - | 100 |

| |
|------------------|
| Rationale |
|------------------|

Plates and Shells have become important structural forms of modern infrastructures. Analysis of such structure requires mathematical Solutions. It is essential to understand structural behavior and analysis of plates and shells for their safe design.

| |
|--------------------------|
| Course Objectives |
|--------------------------|

- 1 To understand theory of plates and shells
- 2 To understand pure bending of plates and also symmetrical bending of circular plates
- 3 To understand deflection of lateral loaded plates and Rectangular plates with edge condition
- 4 To understand the Mathematical representation of shell surface and member theory
- 5 To understand cylindrical bending of shells

Detailed Syllabus

| Module | Course Module / Contents | | Contact hours |
|----------|---|---|---------------|
| 1 | Induction to Theory of Plates | | 3 |
| | 1.1 | Introduction to theory of plates with small and large deflections: | |
| | 1.2 | Distinction between Plate and Shell action | |
| 2 | Pure Bending of plates | | 4 |
| | 2.1 | Pure bending of Thin Plates, Curvature at point, Circle of curvature, Moment Curvature relationships, Relationships Between Twisting moment and Twist of Surface. | |
| 3 | Symmetrical Bending of Circular Plates | | 6 |
| | 3.1 | Symmetrical bending of thin circular plates with small deflection under axis-symmetric transverse loads | |
| | 3.2 | Differential equation of equilibrium for Symmetrical bending for Different support conditions, Plates with overhangs, Plates with co-axial circular opening | |
| 4 | Deflection of lateral loaded plates & rectangular plates with various edge condition | | 10 |
| | 4.1 | Small deflection theory for lateral loaded thin rectangular plates, Various support conditions, | |
| | 4.2 | Navier and Levis solution for uniformly distributed and concentrated loads, Use of numerical technique for the solution of plates, | |
| | 4.3 | Concept of Influence Surface, Study of simply supported plates with continuous edge moment. | |
| 5 | Introduction to shell structures | | 10 |
| | 5.1 | Introduction to Structural behaviour of thin shells, membrane and bending actions | |
| | 5.2 | Mathematical representation of a shell surface, Principal curvatures, Gauss curvature, Classification of shells. | |
| | 5.3 | Membrane theory of thin shells, Stress resultant, Application to cylindrical shells under symmetrical loads and surfaces of revolution under axis-symmetric loads | |
| 6 | Cylindrical Bending | | 6 |
| | 6.1 | Bending theory of closed circular cylindrical shell, stiffness coefficients at free edges along radial and rotational directions. | |
| | 6.2 | Bending theory of spherical shells. Geckelers approximations, stiffness coefficients | |

Contribution to Outcome

On completion of this course, the candidate will be able to

1. Understand the importance of the concepts of theory of Plates and shells.

-
2. Understand the concept of pure bending of plates.
 3. Understand the Concept of small deflections of laterally loaded plates
 4. Understand the mathematical representation of shell surface, membrane theory and cylindrical bending of shells

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

- 1 Timoshenko: 'Theory of Plates and Shells', *McGrawHill Book Co*
- 2 Chandrashekara: 'Analysis of Thin Concrete Shells', *McGrawHill Book Co*.
- 3 Ramaswamy G. S : 'Design and Construction of Concrete Shell Roofs', *McGrawHill Book Co*.
- 4 Varadan T.K. and Bhaskar K 'Analysis of Plates Theory and Problems', *Narros Publishing House*
- 5 J. N. Reddy, "Theory and Analysis of Elastic Plates and Shells", CRC Press, 2006.

Reference Books:

- 1 E. Ventsel and T. Krauthammer, "Thin Plates and Shells", Marcel Dekker, Inc., 2001.
- 2 A. Ugural, "Stresses in Plates and Shells", McGraw Hill, 1999.
- 3 P. L. Gould, "Analysis of Shells and Plates", Springer-Verlag, 1988
- 4 C. L. Dym., "Introduction to the Theory of Shells", Hampshire Publishing Corp., 1990
- 5 Glibson J. E., "*Theory of Cylindrical Shells*", North-Holland Publishing Co

Semester II

| Course Code | Course Name | Credits |
|------------------|-------------------------------|-----------|
| STRPE2011 | Earthquake Engineering | 03 |

Teaching Scheme

| Contact Hours | | | Credits assigned | | | |
|---------------|-----------|-----------|------------------|-----------|-----------|-----------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorials | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | TermWork/Practical/Oral | | | Total |
|---------------------|--------|---------|--------------|--------------------------|-------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | -- | -- | 100 |

Course Objectives

1. To expose students to fundamentals of earthquake engineering.
2. To learn method of deterministic seismic hazard analysis.
3. To illustrate the earthquake characteristics and associated effects on structures.
4. To communicate the concepts of dynamic analysis for civil engineering applications.
5. To study the various methods for strength, stress and load-resistant design.
6. To impart the basic principles for seismic design and construction of structures in accordance with the provisions of Indian Standard Codes.

Detailed Syllabus

| Module | Content | Hours |
|-----------|---|----------|
| I. | Origin of earthquakes, Engineering geology, Seismicity of the world, Faults, Propagation of earthquake waves. Characteristics of Earthquakes: Earthquake terminology, Indian Earthquakes | 6 |
| II | Quantification of earthquake (magnitude, energy, intensity of earthquake), Measurements of earthquake (accelerograph, accelogram recording), Determination of magnitude, Epicentre distance, focal depth, etc | 8 |

| | | |
|-------------|--|-----------|
| III. | Ground motion and their characteristics, Factors affecting ground motions. Concept of response spectra, generation of site-specific spectrum, Estimation of PGA, Earthquake design spectrum and inelastic spectra. | 6 |
| IV. | Concept of earthquake Resistant design, design philosophy, Four virtues of EQRD: Stiffness, Strength, ductility and Configurations, | 7 |
| V. | Introduction to Capacity design concepts and performance based design concepts | 6 |
| VI. | Introduction to IS: 1893, Seismic Coefficient, Response Spectrum Method and Time History Method | 6 |
| | TOTAL | 39 |

Contribution to Outcome

On successful completion of the course students will be able to

1. Understand the fundamentals of earthquake engineering and seismicity conditions of the country and world.
2. Perform site specific deterministic seismic hazard analysis.
3. Analyze earthquake characteristics and associated effects on structures, including linear responses.
4. Understand the concepts of dynamic equations of motion and perform analysis for dynamic systems in civil engineering applications.
5. Evaluate the magnitude and distribution of seismic loads for strength, stress and load-resistant design.
6. Apply the basic principles for seismic design and construction of structures in accordance with the provisions of Indian Standard Codes.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either test. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.

3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

Recommended Books:

1. R.W.Clough and Joseph Penziene: 'Dynamics of Structures', *McGraw Hill Publication*.
2. A.K.Chopra: 'Dynamics of Structures-Theory and Application to Earthquake Engineering', *Prentice Hall Publication*.
3. David Key: 'Earthquake Design Practice for Buildings', *Thomas Telford Publishers*.
4. James M.Kelly: 'Earthquake Resistant Design with Rubber', *Springer-Verlag Publication*.
5. D.J.Dowrick: 'Earthquake Resistant Design for Engineers and Architects', *John Wiley and Sons*.
6. Robinson: 'Passive Vibration control'
7. Agrawal, P. and Shrikhande, M.: 'Earthquake Resistant Design of Structures', *Prentice Hall India, New Delhi, 4th Edition, 2007*.
8. Duggal, S.K.: 'Earthquake Resistant Design of Structures', *Oxford University Press, New Delhi*

Semester II

| Course Code | Course Name | Credits |
|-------------|--|---------|
| STRPE2012 | Health Monitoring and Rehabilitation of Structures | 03 |
| | Program Elective -III | |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|-------------|---------|--------------------|--------------------------------|-----------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test- I | Test- II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

Course Objectives

1. To get familiar with Durability of Structure and Factors affecting durability of concrete structure.
2. To study the Structural health monitoring, condition survey, evaluation and assessment of damage of structure and Testing methods.
3. To acquire the knowledge Repair Materials for Structural Rehabilitation.
4. To study the Repair Methods for Structural Rehabilitation.
5. To implement Retrofitting of Structures and Demolition of Structure.
6. To learn the Rehabilitation process implementation and safety during repairs.

Detailed Syllabus

| Module | Course Module / Contents | | Contact hours |
|--------|--|---|---------------|
| 1 | Structural Health: | | 7 |
| | 1.1 | Durability of Structure, Factors affecting durability, Causes of distresses, Structural Defects due to physical, chemical and environmental factors, climate, chemicals, wear and erosion | |
| | 1.2 | Structural Health, factors affecting health of structures, effect of leakage, age, creep, workmanship, quality of materials used, corrosion, fatigue, regular maintenance, alterations on life of structure | |
| 2 | Structural health monitoring: | | 8 |
| | 2.1 | Structural Audit, Bye laws, Assessment of health of structure, visual survey, Collapse and investigation, limitations on investigator, tools for investigation, Various Destructive, semi destructive and non- destructive Methods for assessing strength of structure. | |
| | 2.2 | Investigation management, review of assimilated information, interviews and statements, Categorization of structure, quantification and preparation of report. | |
| 3 | Repair Materials for Structural Rehabilitation: | | 4 |
| | different types and their uses -Cement, Grouts, Latex modified mortars, Polymer modified mortars, Micro concrete, corrosion inhibitors, Concrete chemicals, epoxy, solvents, bonding chemicals, coatings, waterproofing chemicals, Types of Paints. | | |
| 4 | Repair Methods for Structural Rehabilitation: | | 8 |
| | parameters for assessment for restoration strategies, selection of construction methodology during restoration, Specification for important items of work in restoration, Structural detailing for restoration, and Various techniques of retrofitting, Waterproofing, Structural repairs- jacketing, FRP bonding, Shotcrete, Guniting, Ferroconcrete, Steel plate jacketing Quantity calculations | | |
| 5 | Retrofitting of Structures and Demolition of Structure: | | 4 |
| | Retrofitting of columns, beams, bridge deck and piers, study of structural system and structural drawings, need and importance for demolition, outline of various demolition methods and their evaluation, partial and controlled demolition, role of safety | | |

| | | |
|---|--|---|
| | measures, temporary support structures indemolition. Recycling of demolished materials, contracts. | |
| 6 | Rehabilitation process implementation and safety during repairs: | 8 |
| | <p>Role of client, consulting structural engineer & contractor. Flow of Processes – Bill of quantities and estimate, Tendering, Work order, Agreement and contract, Measurements, Bills/ R. A. Bills, Security deposits, Payment, Role of Project management consultant.</p> <p>Safety during construction- Reasons of accidents, Safety measures, Barricading and fencing, First aid, Insurance, Temporary support structures- formwork, centering, shuttering and staging.</p> | |

Contribution to Outcome

On completion of this course, the candidate will be able to

- 1 Diagnose the distress in Civil Engineering Structures.
- 2 Apply the theoretical concepts of crack repairing in the field.
- 3 Comparison of verities of rehabilitation techniques according to requirement.
- 4 Select the suitable repair technique for deteriorated concrete structures

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be of mixed in nature.
- 4 The students will have to attempt **any four** questions out of **total six** questions.

Recommended Books:

| | |
|---|---|
| 1 | Guha, P.K, “Maintenance and Repairs of Buildings”, New Central Book Agency (P) Ltd, Calcutta, 2011. |
| 2 | Ghosh, S.K, “Repair and Rehabilitation of Steel Bridges”, Oxford and IBH Publishing Co., New Delhi, 1988. |

Reference Books and IS codes:

| | |
|---|---|
| 1 | . Macdonald, S, “Concrete - Building Pathology”, Blackwell Science Limited, Oxford, 2008. |
| 2 | Shetty, M.S, “Concrete Technology – Theory and Practice”, S. Chand and Company Ltd, New Delhi, 2012. |
| 3 | Chudley, R, “The Maintenance and Adaptation of Buildings”, Longman Group Ltd, New York, 2002. |
| 4 | Strecker, P.P, “Corrosion Damaged Concrete – Assessment and Repair”, Butterworths, London, 1987. |
| 5 | Johnson, S.M, “Deterioration, Maintenance and Repair of structures”, Krieger Publishing Company, Melbourne, 1980. |
| 6 | A.R. Santakumar, “Concrete Technology”, Oxford University Press, New Delhi, 2006. |
| 7 | P.K. Mehta and P.J.M. Monteiro, “Concrete - Microstructure, Properties and Materials”, McGraw-Hill, New York, 2014. |
| 8 | . Modi, P.I., Patel, C.N., "Repair and Rehabilitation of Concrete Structures", PHI I |

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| Semester II |
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| Course Code | Course Name | Credits |
|------------------|-------------------------------------|-----------|
| STRPE2013 | Advanced Concrete Technology | 03 |
| | Program Elective-III | |

Teaching Scheme

| Contact Hours | | | Credits assigned | | | |
|---------------|-----------|----------|------------------|-----------|-----------|-----------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorials | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|--------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | -- | -- | 100 |

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| Rationale |
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Basic concept of concrete technology is essential for civil engineering students to execute the civil engineering projects as per the standards laid down time to time. Advancements in concrete technology is the backbone strength of infrastructure of civil engineering field. This course provide necessary knowledge about various concreting and testing operations during and after construction. This course is intended for gaining knowledge about the properties of materials, especially concrete and to maintain quality of construction projects. This course will also provide knowledge to the students about the criteria to be remembered during the selection of materials, its mix proportioning, mixing, placing, compacting, curing and finishing.

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| Course Objectives |
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To understand the various constituent materials of concrete.

- To study the different properties of fresh and hardened concrete.
- To understand the concept and optimization of the mix design of concrete by using various codes.
- To understand the evaluation technique of concrete using semi and non-destructive techniques for better stability and safety of structures periodically.
- To study the various constituents, properties, significance and applications of special concrete.
- To understand the concept of durability and deterioration in concrete.
- To understand the significance of parameters in concreting under extreme environmental

conditions.

Detailed Syllabus

| Module | Content | Hours |
|-------------|--|-----------|
| I. | Constituent Materials of Concrete: | 03 |
| | Components of modern concrete and developments in the process and constituent materials. | 01 |
| | Mineral and Chemical Admixtures: Fly Ash (Physical and Chemical properties), Silica Fume (Physical and Chemical properties), Rice Husk Ash, Metakaolin, Ground Granulated Blast Furnace Slag (Physical and Chemical properties).Introduction to accelerators, retarders, plasticizers, super plasticizers, viscosity modifying admixtures, water proofers, miscellaneous admixtures. | 02 |
| II | Properties of Fresh and Hardened Concrete: | 09 |
| | Properties of fresh Concrete: Workability, Compactability, Mobility, Stability, Consistency, Segregation and Bleeding, w/c ratio, w/b ratio, gel space ratio, and aggregate cement bond strength. | 02 |
| | Rheological Models of Fresh Concrete: Introduction, Simple Flow Test, Rheological Models, Schematic Differences in flow curves, Factors affecting rheological properties and effects. | 02 |
| | Hardened Concrete: Strength Under Uniaxial and multiaxial stresses, Failure Modes, Tensile strength, Fatigue, Impact Strength, Abrasion Resistance, Fracture properties of concrete. | 02 |
| | Dimensional Stability of Concrete: Introduction, Modulus of Elasticity (Static and Dynamic), Factors affecting modulus of elasticity, Poisson's Ratio, Mechanics of setting and hardening, shrinkage, creep and thermal properties of concrete | 03 |
| III. | Proportioning of Concrete Mixes: | 08 |
| | Approach to Concrete Mix Design, Principles and Properties related to Mix (Durability, Workability and Strength), Physical Properties of materials required for mix design, Variability of test results. | 02 |

| | | |
|------------|--|-----------|
| | Methods for Mix Proportioning: Trial Mix, Nominal Mix, Mix Design by Bureau of Indian Standards Method 10262:2019 (With and without fly ash), Mix Design by American Concrete Institute Method, Mix Design by Department of Environment Method, Mix Design by Fineness modulus method. Mix design of high strength concrete by ACI method 211.4R-93. | 05 |
| | Acceptance Criteria for Concrete: Determining the laboratory Design strength of concrete, Quality Control of concrete. | 01 |
| IV. | Non-& Semi destructive testing methods: | 04 |
| | Probe Penetration, Pull Out Test, Break Off Maturity Method, Stress Wave Propagation Method, Infrared Thermography, Carbonation Test, Dye penetration examination, Linear Variable Differential Transformer and Contact type strain gauge. | 04 |
| V. | Special Concrete: | 08 |
| | Light weight concrete – Types of lightweight aggregate, Physical and Mechanical Properties, Factors affecting strength and density of light weight aggregates, properties of light weight concrete. | 01 |
| | Fiber Reinforced Concrete - Historical development of fibre reinforced concrete, Physical and Mechanical properties of natural, metallic and synthetic fibers. Interaction between fibres and matrix (uncracked and cracked matrix), Properties of hardened Steel fibre reinforced concrete. | 02 |
| | High Strength and High-performance Concrete – Microstructure, Manufacturing considerations, Properties of high strength concrete, advantages, applications and cost implications. | 02 |
| | Ferrocement and Porous Concrete – Materials, behaviour of ferrocement in tension, construction methods, applications and case studies of ferrocement in structures. Introduction of porous concrete, Need for porous concrete, construction of pervious concrete pavement. | 02 |
| | Self-Compacting Concrete – Properties of fresh and hardened self-compacting concrete, introduction to mix designs of self-compacting concrete, peculiarities in mixing and transportation of self-compacted concrete. | 01 |
| VI. | Durability and Deterioration of concrete: | 07 |
| | Durability Concrete in Special Environments - Introduction to durability and permeability, cracking in concrete, Frost Attack, Aggressive environment, Marine environment, High temperature or Fire and Radiation Shielding. | 02 |
| | Design of Durability using performance specification – performance-based specification, durability index method, durability index tests. | 02 |
| | Deterioration and repair technology of concrete, Distress and type of repairs, crack sealing techniques. | 03 |
| | Total | 39 |

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| Contribution to Outcome |
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On successful completion of the course, the learners shall have an in-depth knowledge of the advanced concrete technology and its application in the diverse spectrums of the Civil Engineering. The students will be able to

1. Study the materials science aspects of the properties and behavior of modern constituents of concrete.
2. Understand the various properties and tests performed on fresh and hardened concrete.
3. Design the concrete mix for field application by different methods and discuss the quality and acceptance criteria of concrete.
4. Understand the implementation of semi and non-destructive testing methods for inspection and testing of various structures.
5. Explain the various properties and behaviour of special concrete.
6. Describe the durability and deterioration of concrete and apply the knowledge of durability in extreme weather concreting.

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

1. Concrete Technology: Santhakumar, *Oxford University Press*.
2. Concrete Technology: A.M. Neville and Brooks
3. Properties of Concrete: Murdock.
4. Properties of Concrete: P. K. Mehta.
5. Concrete Technology: M. S. Shetty.
6. Fiber Reinforced Cement Composite: P.N. Balguru and P. N. Shah.
7. Concrete Technology: D.F. Orchard
8. Concrete Technology: Gambhir, 3rd edition, *Tata Mc Graw Hill*

Semester- II

| Course Code | Course Name | Credits |
|-------------|----------------------------------|---------|
| STRPE2014 | Advanced Finite Element Analysis | 03 |
| | Program Elective III | |

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test -I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

Rationale

Advanced Finite Element analysis is a numerical technique for solving differential equations that describe many engineering problems. Main reason for its popularity is that the method results in computer codes which are versatile in nature that can solve many practical problems with minimum training. This course of advanced finite element analysis covers the fundamental concepts and its designed for students in civil engineering, researchers and design engineers in the structural engineering field. The course presents the FEM as a tool to find approximate solution of differential equations and thus can be used by students. Applications include analysis of structural frameworks, stress analysis and programs etc.

Course Objectives

1. To understand the basics, advantages, significance of finite element analysis and the various methods used in finite element formulation.
2. To understand geometric non-linearity, material non-linearity in two dimensional elements and general formulation of a physically non-linear problem.
3. To study Finite Element Analysis of Plate and Shell
4. To study the Analysis of Three-Dimensional Problem
5. To understand terminology, Finite element Discretization, system of units, Stages in solution using ANSYS.
6. To understand Analysis of Space Trusses, plates subjected to in-plane loads using CST elements, Three –Dimensional Structures using CST element by MATLAB programs

Detailed Syllabus

| Module | Course Modules / Contents | Hrs |
|------------|--|---------------|
| I | Basics of Finite Element Analysis | 05hrs |
| | Review of Variation methods- Calculus of variation- Variational Principles of solid Mechanics. The Basic component- Concept of an element- Various Element Shapes Displacement models- Formulation of Finite Element Method. Derivation of Element Stiffness and loads for Pin Jointed Bar element, Beam element, Triangular and Rectangular Plate Element in Bending. Isoparametric element- Local vs. Natural Co-ordinates system, Line, Triangular, Quadrilateral and Tetrahedral Element Interpolation Displacement Models Formulation of Isoparametric. General steps involved in finite element analysis. Calculations of Element Stresses. | |
| II | Non-Linear analysis using Finite Element Analysis: | 07 hrs |
| | Introduction to Non-Linear Analysis, Geometric Non-Linearity- Geometric Stiffness of an Axial Element, Stability of Bar Spring System. General Formulation of a Geometrically Nonlinear problem. Geometric Stiffness of a Beam-Column of Triangular element. Non-linear material behaviour. Non-linear spring- Elastic Plastic Analysis by FEM-Elasto-Plastic Analysis of Truss-Two-Dimensional Element Formulations- General Formulation of a Physically Non-linear Problem Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysis of Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame | |
| III | Plate and shell and applications of Finite Element Analysis | 08 hrs |
| | Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate - Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate -Introduction to Finite Strip Method - Finite Element Analysis of Shell -Finite Elements for Elastic Stability - Dynamic Analysis | |
| IV | Analysis of Three-Dimensional Problem | 07 hrs |
| | Introduction, Tetrahedron Element, Hexahedron element, Analysis of solids of Revolution. | |

| | | |
|-----------|--|---------------|
| V | Finite Element Analysis using ANSYS | 06 hrs |
| | Introduction, GUI layout in ANSYS, terminology, Finite element Discretization, system of units, Stages in solution. | |
| VI | MATLAB programs for Finite Element Analysis | 06 hrs |
| | Solution of linear system of equations using Choleski Method, Incorporation of boundary conditions, Analysis of Space Trusses, Analysis of plates subjected to in-plane loads using CST elements. Analysis of Three –Dimensional Structures using CST element. | |
| | Total | 39 |

Contribution to Outcome

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

1. Understand the basics, advantages, significance of finite element analysis and the various methods used in finite element formulation.
2. Understand geometric non -linearity, material non-linearity in two dimensional elements and general formulation of a physically non-linear problem.
3. Analyze Plate and Shell using Finite Element Analysis.
4. Analyze the Three-Dimensional Problem using Finite Element Analysis.
5. Understand terminology, Finite element Discretization, system of units, Stages in solution using ANSYS.
6. Understand Analysis of Space Trusses, plates subjected to in-plane loads using CST elements, three –Dimensional Structures using CST element by MATLAB programs.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

5. Question paper will comprise of **six** questions; each carrying 20marks.
6. There can be an **internal** choice in various sub-questions/questions in order to accommodate the questions on all the topics/ sub-topics.
7. The students will have to attempt any **four** questions out of **total six** questions.
8. The questions can be of mixed **nature** irrespective of modules

Recommended Books:

15. Zienkiewicz, O.C.: 'The Finite Element Method in Engineering Science', *McGraw Hill Book Co.*
16. J.N.Reddy : 'Finite Element Analysis', *McGraw Hill Book Co.*
17. Chandragupta, T.R. and Belagundu, A.D.: 'Introduction to Finite Elements in Engineering', *Prentice Hall of India Pvt. Ltd.*
18. Rajshekaran, S.: 'Finite Element Analysis', *Wheeler Publishing.*
19. Krishnamoorthy C.S.: 'Finite Element Analysis', *McGraw Hill Book Co.*
20. Cook, R.D., Malkus, D.S. and Plesha, M.E.: 'Concepts and Applications of Finite Element Analysis', *John Wiley and Sons (Asia) Pvt. Ltd.*
21. Bickford, W.B.: 'A First Course in Finite Element Method', *IRWIN, Homewood, IL 60430*
22. Rao, S.S.: 'The Finite Element Method in Engineering', *Pergamon Press.*
23. Weaver, W. and Johnston, P.R.: 'Finite Element for Structural Analysis', *Prentice Hall.*
24. M. Asghar Bhatti, "Fundamental Finite Element Analysis and Applications with Mathematical and MATLAB Computations", *Wiley India Pvt. Ltd.*
25. Chandrupatla and Belegundu, "Introduction to Finite Elements in Engineering" *PHI / Pearson Education, 2003.*
26. Logan, D.L. "A first course in Finite Element Method", *Thomson Asia Pvt. Ltd., 2002.*
27. S.S. Bhavikatti "Finite Element Analysis" New Age International Publication.
28. Y. M. Desai "Finite Element Method" Pearson.

| |
|--------------------|
| Semester II |
|--------------------|

| Course Code | Course Name | Credits |
|-------------|---------------------------------|---------|
| STRPE2021 | Design of Industrial Structures | 03 |
| | Program Elective -4 | |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | - | - | - | 100 |

| |
|------------------|
| Rationale |
|------------------|

Good structural engineer requires efficient knowledge of design of an industrial structural who can design safe and cost-effective structure. An efficient structural designer can create structures that can last forever. These are different types of the industrial structures which are subjected to various types of loading and its combination. These structures are made of RCC, Steel or composite material. The structures are designed by working stress method and limit state method.

| |
|--------------------------|
| Course Objectives |
|--------------------------|

On completion of this course, the learner will be able to

- 1 To be thorough with the design of industrial steel structures and connection viz. bolted and welded and detailing of reinforcement in Industrial RCC Structure.
- 2 To understand the design concept of lattice tower
- 3 To understand the analysis and design concept of round tubular structures.
- 4 To know the analysis and design of chimney.
- 5 To understand the design concept of gantry girder.

Detailed Syllabus

| Module | Course Module / Contents | | Contact hours |
|----------|--|---|---------------|
| 1 | INDUSTRIAL ROOF TRUSS | | 9 |
| | 1.1 | Introduction; Types; Loads-Dead loads, live loads and wind loads | |
| | 1.2 | Design wind speed and pressure; wind pressure on roofs | |
| | 1.3 | Analysis and design of tubular trusses including purlins and supports | |
| 2 | DESIGN OF STEEL BUNKERS AND SILOS | | 7 |
| | 2.1 | Introduction of steel bunkers and silos | |
| | 2.2 | Janssen's Theory; Airy's Theory | |
| | 2.3 | Design of Parameters; Design Criteria; Analysis of Bins; Hopper Bottom Design of Bins. | |
| 3 | STEEL CHIMNEY | | 7 |
| | 3.1 | Introduction; Behaviour of chimney | |
| | 3.2 | Design of self - supporting chimney - Design of base plates, foundations and anchor bolts | |
| | 3.3 | Guyed steel chimney | |
| 4 | GANTRY GIRDER | | 7 |
| | 4.1 | Introduction; Loads acting on gantry girder | |
| | 4.2 | Analysis and Design of gantry girder | |
| 5 | TRANSMISSION LINE TOWERS | | 9 |
| | 5.1 | Introduction; Types; component parts | |
| | 5.2 | Types of bracing patterns; Sag and tension calculations | |
| | 5.3 | Analysis and design of lattice transmission line towers | |
| | | Total | 39 |

Contribution to Outcome

On completion of this course, the candidate will be able to

- 1 Independently design steel structures using relevant IS codes.
- 2 Design various components of industrial structure such as purlins, girts and tie runner etc.
- 3 Design Industrial structures subjected to wind load.
- 4 Analysis and design of gantry girder, lattice tower and tubular truss.
- 5 Analysis and design chimney.

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:**End Semester Examination**

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be of mixed in nature.
- 4 The students will have to attempt **any four** questions out of **total six** questions.

Recommended Books:

| | |
|---|---|
| 1 | Design of Steel Structures: P.Dayaratnam, S. Chand, Edition 2011-12. |
| 2 | Limit State Design of Steel Structures: S.K. Duggal, Mc Graw Hill Education Private Ltd., NewDelhi. |
| 3 | Design of Steel Structures: Galyord& Gaylord, Publisher, Tata Mc Graw Hill, Education. Edition 2012 |
| 4 | Design of Steel Structures: Punamia, A. K. Jain and Arun Kumar Jain, Laxmi Publication |
| 5 | Design of Steel Structures : N Subramanian, Oxford- University Press |

Reference Books and IS codes:

| | |
|---|--|
| 1 | Design of Steel Structures: Kazimi, S. M. and Jindal, R. S., Prentice Hall of India |
| 2 | Design of Steel Structures: Breslar, Lin and Scalzi, John Willey, New York. |
| 3 | Design in structural steel: John E. Lothers, Prentice Hall of India |
| 4 | IS:800-2007-General Construction in Steel - Code of Practice |
| 5 | IS: 1498-1970, "Classification and Identifications of soils for General Engineering Purposes". |
| 6 | IS:9178 (Part-I)-1979, General requirements and assessment of loads |
| 7 | IS:9178 (Part-II)-1979; Criteria for design of steel bins for storage of bulk materials |
| 8 | IS:9178 (Part-III)-1980: Bins Designed for Mass Flow and Funnel Flow |

| | |
|----|---|
| 9 | IS:3177-1999: Code of practice for electric overhead travelling cranes and gantry cranes other than steel work cranes |
| 10 | IS:806-1968: Code of practice for use of steel tubes in general building construction |
| 11 | IS:802-2015: Use of structural steel in overhead transmission line towers - code of practice |

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|--------------------|
| Semester II |
|--------------------|

| Course Code | Course Name | Credits |
|-------------|---------------------------|---------|
| STRPE2022 | Design of Green Buildings | 03 |
| | Program Elective -4 | |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|-------------|---------|--------------------|-----------------------------------|-----------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test- I | Test- II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hours | - | - | - | 100 |

| |
|------------------|
| Rationale |
|------------------|

Basics of Civil Engineering/Architecture/Infrastructure/Planning Knowledge, National Building Code-2016, Development Control Rules (DCR), Building Bye Laws, Model Building Development Control Rules, Building Planning, Design and Constructions.

| |
|--------------------------|
| Course Objectives |
|--------------------------|

1. To acquire knowledge on various aspects of green buildings.
2. To learn practices Indian Green Building Council.
3. To introduce green building design.
4. To learn material conservation handling of non process non- recycled waste.
5. To study national as well international, green building assessment system.
6. To study various terminologies Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management

Detailed Syllabus

| Module | Course Module / Contents | Contact hours |
|--------|---|---------------|
| 1 | Green Building Concepts: | 5 |
| | What is Green Building, Why to go for Green Building, Benefits of Green Buildings, Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building? Principles of green building–Selection of site and Orientation of the building–usage of low energy materials– effective cooling and heating systems– effective electrical systems– effective water conservation systems. | |
| 2 | Green Building Practices in India: | 7 |
| | . Practices of Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Building, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings | |
| 3 | Introduction to Green Building Design | 7 |
| | Green Building Design Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximize System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources. Eco-friendly captive power generation for factory, Building requirement. | |
| 4 | Material Conservation Handling of Non-Processed Waste: | 7 |
| | Material Conservation, Handling of non-processed waste, waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture; Indoor Environment Quality And Occupational Health: Air conditioning, Indoor air quality, Sick building syndrome, Tobacco smoke control, Minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, Measure of Indoor Air Quality (IAQ), Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels. | |
| 5 | Green building Rating Systems: | 7 |
| | Green building assessments system studying e.g. LEED US (Leadership in Energy and Environmental Design); Living Building Challenge, Green Globes (Green Building Initiative) (US), Green Globes (EBC-Canada; LEED-Canada, Built Green CANADA, BREEAM (Building Research Establishment Environmental Assessment Method) (UK), LEED India (Indian GBC); IGBC Green modules; TERI-GRIHA (Green Rating for Integrated Habitat Assessment) (India) Rating system various modules | |
| 6 | Embodied Energy, Life Cycle Assessment, Environmental Impact | 6 |

| | | |
|--|--|--|
| | Assessment, Energy Audit and Energy Management | |
| | Introduction to the Concept: “Life Cycle assessment of materials”. EIA: Introduction to EIA. Process of EIA and its application through a case study, EIA as a strategic tool for sustainable development. Embodied energy of various construction materials-Energy Management with respect to buildings, Clean Development Mechanism, Kyoto Protocol, Energy Conservation Building Code | |

Contribution to Outcome

On completion of this course, the learner will be able to

1. Understand the concepts of green building.
2. Learn practices of Indian Green Building Council and GRIHA.
3. Learn material conservation and handling of non-recycled non-processed waste.
4. Learn green building assessment systems national as well international.
5. Study various terminologies Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management system.

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

1. Green Building Materials by Ross Spiegel and Dru Meadows
2. Sustainable Building Design Manual-Volume-I, II, III, IV, V by TERI Publications
3. Mechanical and Electrical Systems in Construction and Architecture by Frank R.Dagostino
4. Sustainable Building Design Manual-Volume-I, II, III, IV, V by CII-Godrej- IGBC Publications
5. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison “Green Building Handbook” Volume I, Spon Press, 2001

Reference Books

1. Manual of Tropical housing and climate change by Koenigsberger
2. Climate responsive Architecture by Arvind Krishnan
3. Manual of solar passive Architecture by Nayak J.K., R. HazzraJ.Prajapati
4. Energy Efficient buildings in India by Mili Mujumdar
5. Publications from-CBRI-Roorkee, IDC-Mumbai, NID-Ahmedabad, SERC, BMTPC
6. Solar Energy in Architecture and Urban Planning by Herzog Thomos
7. Solar Heating, Design Process by Kreider Jan F
8. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
9. Green Building Hand Book by Tom woolley and Sam kimings, 2009.
10. Green building codes and standards
11. International Green Construction Code
12. Complete Guide to Green Buildings by Trish riley
13. Shahane, V. S, "Planning and Designing Building", Poona, Allies Book Stall, 2004.
14. Michael Bauer, Peter Mösele and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
15. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

| |
|--------------------|
| Semester II |
|--------------------|

| Subject Code | Subject Name | Credits |
|--------------|---|---------|
| STRPE2023 | Design of Environmental and Hydraulics Structures | 03 |
| | Program Elective -IV | |

Teaching Scheme

| Contact Hours | | | Credits assigned | | | |
|---------------|-----------|----------|------------------|-----------|-----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorials | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term work/Practical/Oral | | | Total |
|---------------------|--------|---------|--------------------|-----------------------------------|-----------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 | -- | -- | -- | 100 |

| |
|------------------|
| Rationale |
|------------------|

Design of Environmental And Hydraulics Structures provides necessary knowledge about design and constructions of important environmental-hydraulic structures like units of WTP, STP, dams, reservoirs, weirs, cross drainage works and canal structures. This subject is taught to understand the concepts of pipe network and design. A student, who successfully completes the course, should be able to design various structures in the given field conditions.

| |
|--------------------------|
| Course Objectives |
|--------------------------|

1. To impart necessary skill required for the design of water treatment units.
2. To study the basic principles used in designing sewage treatment plant.
3. To understand the design for water tank.
4. To design the section of spillway and energy dissipaters.
5. To study design of Aqueduct and design canal regulation works.
6. To study the concepts of pipe network and design.

| Detailed Syllabus | | |
|--------------------------|--|---------------|
| Module | Course Modules / Contents | Period |
| I | Design of water treatment plant | 07 hrs |
| | Flash mixer, Flocculator, settling tanks, Rapid sand filter. Ground service reservoir and Elevated service reservoir, Jack Well, Pump House | |
| II | Design of sewage treatment plant | 07 hrs |
| | Design of primary settling tank and other units of sewage/effluent treatment plant, Design of grit chambers, Design criteria for digester and UASB | |
| III | Design of water tanks | 06 hrs |
| | Design of underground water tanks, Design of water tanks resting on ground: circular & rectangular tanks | |
| IV | Spillway | 07 hrs |
| | Spillway Necessity, components and classification, Design consideration of overflow/ogee spillway, Design as per IS, Design of hydraulic jump type energy dissipaters-stilling basin as per IS , design of roller bucket type energy dissipaters | |
| V | Aqueducts | 07 hrs |
| | Types of aqueducts and syphon aqueducts, Design of aqueducts, Design of weirs and barrages over permeable foundations, causes of failure, Khosala's theory, Canal regulation works: alignment of off-taking channels, distributor head regulator, cross regulator and their design | |
| VI | Design of concrete pipes | 05 hrs |
| | Pipes-Pre-stressed concrete, steel and cast iron, Classification of R.C.C and pre-stressed pipe, Design principles, Reinforcements in pipes, Design of non-pressure R.C.C.pipes for culverts, laying of concrete pipes. | |
| | Total | 39 |

Contribution to Outcome

On completion of this course the student shall be able to

1. Understand the basic principles used in the design of water treatment units.
2. Analyze and design the sewage treatment plant.
3. Design circular and rectangular water tank.

4. Design ogee spillway and energy dissipaters.
5. Design of aqueduct and understand concept of canal regulation works.
6. Understand the concepts of pipe network and design.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for the either tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of six questions; each carrying 20 marks.
2. There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any four questions out of total six questions.
4. The questions can be of mixed nature irrespective of modules

Recommended Books:-

1. P. Dayaratnam, (2004), Reinforced Concrete, Oxford Publishing Private Limited.
2. Krishna Raju, (2004), Prestressed Concrete, Tata McGraw Hill Publishing Co, 2nd Edition.
3. N.C. Sinha & S.K. Roy, (2002), "Reinforced Concrete, S. Chand and Co.
4. Ramaswamy. G.S., (1996), Design and Construction of Concrete Shell roofs CBS Publishers, India.
5. Jain, S.K., Jaiswal, O.R., "Guidelines for seismic design of liquid storage tanks", NICEE, IIT K, 2004
6. Anchor, R.D., "Design of liquid retaining concrete structure" Edward Arnold,
7. BIS, IS-3370, "Indian standard code of Practice for Concrete Structure for the storage of Liquids", Part-I to IV
8. Ghali, A., "Circular storage tanks and Silos", E & F N Spon, London, 1979
9. Irrigation Water Resources and Water Power Engineering: *P.N. Modi*, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
10. Irrigation Engineering and Hydraulic Structures: *S. K. Ukarande*, Ane's Books Pvt. Ltd. (Abridged Edition 2015), ISBN 9789383656899
11. Irrigation and Water Power Engineering: *B.C. Punmia, Pande, B.B. Lal, A.K Jain*. Laxmi Publications Pvt, Ltd. New Delhi.
12. Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi.
13. Design of Irrigation Structures: *S. K. Sharma*, S. Chand and Co.
14. Theory and Design of Irrigation Structures: *R. S. Varshney and R. C. Gupta*, Nem Chand and Bros., Roorkee
15. Engineering for Dams, Vol. I to III: *Crager, Justin and Hinds*, John Wiley
16. Design of Small Dams: USBR.
17. Water Supply Engineering, S.K. Garg, Khanna Publication.
18. Sewage disposal and Air Pollution Engineering, S.K. Garg, Khanna Publication.
19. CPHEEO Manual on Water Supply and Treatment
20. CPHEEO Manual on Sewage and Treatment

Semester II

| Course Code | Course Name | Credits |
|------------------|------------------------------------|-----------|
| STRPE2024 | Design of Bridge Structures | 03 |
| | Program Elective -IV | |

Teaching Scheme

| Contact Hours | | | Credits Assigned | | | |
|---------------|-----------|----------|------------------|-----------|----------|-----------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | -- | -- | 03 |

Evaluation Scheme

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---------------------|---------|---------|--------------|--------------------------|--------------------------|----|----|-------|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 3 | - | - | | 100 |

Rationale

Bridge engineering is a field of engineering (particularly a significant branch of structural engineering) dealing with the surveying, plan, design, analysis, construction, management, and maintenance of bridges that support or resist loads. A bridge is a construction made for carrying the road traffic or other moving loads in order to pass through an obstacle or other constructions. The required passage may be for pedestrians, a road, a railway, a canal, a pipeline, etc. Obstacle can be rivers, valleys, sea channels, and other constructions, such as bridges themselves, buildings, railways, or roads. The mission of a bridge design may be defined as “to design a safe, functional, and beautiful bridge within the given budget.”

Course Objectives

1. To study the aspect of survey methodology, hydraulics and waterways study, bridge analysis, design and its philosophy.
2. To study the type of bridge selection.
3. To study the design theories.
4. To study the different code provisions and requirements in analysis and design of bridges.
5. To study the design of superstructure and substructure.
6. To study different software available for analysis and design. (Like MIDAS etc.)

7. To study inspection, maintenance, monitoring, testing and rehabilitation methodology for bridges.

Detailed Syllabus

| Module | Course Module / Contents | | Contact Hrs. |
|----------|--|---|--------------|
| 1 | Introduction to Bridge Structures and Fundamentals of Bridge Design | | 4 |
| | 1.1 | Historical review of bridges | |
| | 1.2 | Investigations, surveying, site selections, spanning arrangement, selection type of bridges, different materials used and advanced material used for bridge construction. | |
| | 1.3 | Hydraulics and water ways of bridges | |
| | 1.4 | General design requirements, GAD preparation. | |
| 2 | Loads and Load distributions | | 5 |
| | 2.1 | I.R.C. and BIS specifications for loads and material for bridges. | |
| | 2.2 | Different types of loadings including environmental loadings and their combinations for design. Load path. | |
| | 2.3 | Load distribution theories: Courbon's Method, Hendry Jaeger Method, Grillage analogy, Pigeaud's curves etc Bridge modelling for analysis and modelling in software. | |
| 3 | Design of Bridge Superstructure | | 11 |
| | 3.1 | Design of RCC and Prestressed slab/girder/box Bridges. | |
| | 3.2 | Design of steel bridges like plate girder, truss bridge and composite bridge. | |
| | 3.3 | Analysis and design concept of cable stayed, extradosed, arch, bowstring and other types of bridges, their load path, component and proportion of element. | |
| 4 | Design of Bridge Substructure | | 10 |
| | 4.1 | Various parts of substructures, Various types of substructures, Loads acting on substructures, | |
| | 4.2 | Design of pier and pier cap | |
| | 4.3 | Design of Abutment, returns, RE wall design and other component. | |
| | 4.4 | Introduction to bridge foundation, different types of foundation and their selection. | |
| 5 | Bridge Bearings & expansion joints | | 6 |
| | 5.1 | Bearings: General features, types design and replacement. | |
| | 5.2 | Expansion joints: Requirement, types and selection. Bridge centering design, different erection techniques, launching girder, bridge construction machinery. | |
| 6 | Inspection, maintenance, monitoring, load testing and rehabilitation of Bridges | | 3 |

| | | | |
|--|-----|---|-----------|
| | 6.1 | Inspection methods, maintenance strategy, different types of monitoring and instrumentation, load testing and rating of bridges, different rehabilitation techniques. | |
| | | Total | 39 |

Contribution to Outcome

On completion of this course, the learner will be able to

- 1 Understand the bridge structures & their types and make capable to select appropriate bridge type and able to prepare bridge GAD
- 2 Understand the design theories and loadings.
- 3 Understand the codal provisions and requirements
- 4 Understand the design of superstructure
- 5 Understand the design of substructure
- 6 Understand the bridge inspection procedures.

Internal Assessment

20 Marks

The internal assessment consists of two tests, i.e., mid-semester and end semester. The learner/s shall be asked to appear for either the tests. However, at least one test is mandatory and the learner/s may be asked to undertake the completion of assignment on live problems or course project instead of another test, solely at the discretion of the course instructor.

Theory Examination:

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six** questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

1. Design of Bridges”, N.Krishna Raju, Oxford & IBH Publishing Co.Pvt.Ltd, New Delhi
Bridge Deck Behaviour by E.C. Hambly.
2. Design of Bridges by V.V. Sastry, Dhanpat Rai & Co
3. Concrete Bridge Design and Practice by V.K. Raina.
4. Design of Bridge Structures by Jagadeesh & Jayaram, PHI learning Pvt. ltd.
5. All IRC, BIS codes.
6. Essentials of Bridge Engineering by Victor D J & Johnson, Oxford & IBH publishers.
7. Bridge Engineering Bindra S P D publisher DhanpatRai& Co.

Reference Books:

1. R. Rajagopalan, "Bridge Superstructure", Tata McGraw- Hills Publishing Company Limited.
2. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Fundamentals, CRC Press.
3. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Superstructure Design, CRC Press.
4. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Construction & Maintenance, CRC Press.
5. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Seismic Design, CRC Press.
6. Chung C. Fu, Wang Shuqing, Computational Analysis & Design of Bridge Structures, CRC Press.
7. NPTEL

| SemesterII | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRIE2021 | InstituteLevelElective:ProjectManagement | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|----------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | EndSem Exam | Durationof End SemExam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

| Module | DetailedContents | Hrs |
|------------|--|----------|
| I | ProjectManagement Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI). | 5 |
| II | Initiating Projects: How to get a project started, selecting project strategically, Project selection models (Numeric/Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics. | 6 |
| III | Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottom up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS). | 8 |
| IV | Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, | 6 |

| | | |
|-----------|---|----------|
| | ProjectStakeholdersand Communicationplan. RiskManagementinprojects:Riskmanagementplanning,Riskidentificationand riskregister.Qualitativeandquantitative riskassessment,Probabilityandimpactmatrix.Ri sk response strategiesforpositiveandnegative risks | |
| V | 5.1 ExecutingProjects: Planningmonitoringandcontrollingcycle.Informationneedsandreporting,engagingwith all stakeholders of theprojects. Teammanagement,communicationandproject meetings. 5.2 MonitoringandControllingProjects: EarnedValueManagementtechniquesformeasuringvalueofworkcompleted;Usingmiles tonesformeasurement;changerequestsand scopecreep. Projectaudit. 5.3 ProjectContracting Projectprocurementmanagement,contractingandoutsourcing, | 8 |
| VI | 6.1 ProjectLeadershipandEthics: Introductiontoprojectleadership,ethicsinprojects.Mu lticulturaland virtual projects. 6.2 ClosingtheProject: Customer acceptance; Reasons ofproject termination, Various types ofprojectterminations(Extinction,Addition,Integration,Starvation),Processofprojecttermination,completingafinalreport;doingalessonslearnedanalysis;acknowledgingsucces sesandfailures;Projectmanagementtemplatesandother resources;Managingwithoutauthority;Areas offurtherstudy. | 6 |

Outcomes

Studentswill be ableto:

- Applyselectioncriteriaandselectanappropriateprojectfromdifferent options.
- Writeworkbreak downstructureforaprojectanddevelopa schedulebasedonit.
- Identifyopportunitiesandthreatstotheprojectanddecideanapproachtodealwiththemstrategically.
- UseEarned value techniqueand determine&predict status ofthe project.
- Capturelessons learnedduringprojectphasesanddocumentthem forfuturereference

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstestandtheotheriseitheraclass test or assignmenton liveproblems or courseproject.

EndSemesterTheoryExamination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in questionpapers of end semester examination. **In question paper weightage of each module will be proportionaltonumberofrespective lecturehours asmention inthesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestion carryequalmarks
3. Questionswillbemixedinnature(forexamplesupposedQ.2haspart(a)frommodule3thenpart (b)will befrom anymodule other than module3)
4. OnlyFour question needtobe solved.

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9th Ed.

| SemesterII | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRIE2022 | InstituteLevelElective:FinanceManagement | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End Sem Exam | Durationof End SemExam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- OverviewofIndianfinancialsystem,instruments andmarket
- Basicconceptsofvalueofmoney,returnsandrisk,corporatefinance,workingcapitalanditsmanagement
- Knowledgeaboutsourcesoffinance,capitalstructure,dividendpolicy

| Module | DetailedContents | Hrs |
|------------|---|-----------|
| I | Overview of Indian Financial System: Characteristics, Components and FunctionsofFinancial System. FinancialInstruments: Meaning,CharacteristicsandClassificationofBasicFinancialI nstruments—EquityShares,PreferenceShares,Bonds- Debentures,CertificateofDeposit, and TreasuryBills. FinancialMarkets: Meaning,CharacteristicsandClassificationofFinancialMarkets— Capital Market, MoneyMarket and Foreign CurrencyMarket FinancialInstitutions: Meaning,CharacteristicsandClassificationofFinancial Institutions—CommercialBanks,Investment-MerchantBanksandStockExchanges | 06 |
| II | Concepts of Returns and Risks: Measurement of Historical Returns and ExpectedReturnsofaSingleSecurityandaTwo- securityPortfolio;MeasurementofHistoricalRiskandExpectedRiskofaSingleSecuritya ndaTwo- securityPortfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, andAnnuityDue;PresentValueofaLumpSum,OrdinaryAnnuity,andAnnuityDue; ContinuousCompoundingandContinuousDiscounting. | 06 |
| III | Overview of Corporate Finance: Objectives of Corporate Finance; Functions ofCorporateFinance— InvestmentDecision,FinancingDecision,andDividendDecision. FinancialRatioAnalysis: OverviewofFinancialStatements—BalanceSheet, ProfitandLossAccount,andCashFlowStatement;PurposeofFinancialRatio | 09 |

| | | |
|-----------|--|-----------|
| | Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis. | |
| IV | Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities. | 10 |
| V | Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches—Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure | 05 |
| VI | Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach | 03 |

Outcomes

Students will be able to...

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. FundamentalsofFinancialManagement, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

| SemesterII | | |
|-------------|---|---------|
| Course Code | Course Name | Credits |
| STRIE2023 | InstitutelevelElective: EntrepreneurshipDevelopmentand Management | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|-----|--------------|------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End SemEx am | Durationof EndSemEx am | TW | PR | OR | |
| Test1 | Test2 | Avg | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- Toacquaintwithentrepreneurship andmanagementofbusiness
- Understand Indianenvironmentforentrepreneurship
- Ideaof EDP,MSME

| Module | DetailedContents | Hrs |
|------------|---|-----------|
| I | OverviewofEntrepreneurship: Definitions, Rolesand Functions/ Valuesof Entrepreneurship, Historyof Entrepreneurship Development, Roleof Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship | 04 |
| II | Business Plans and Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevanceto Business Operations | 09 |
| III | Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises | 05 |
| IV | Indian Environment for Entrepreneurship: key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organizations, departments, bank setc., Role of State governments in terms of infrastructure developments and | 08 |

| | | |
|--|--|--|
| | supportetc.,Publicprivatepartnerships,NationalSkilldevelopmentMission,Credit | |
|--|--|--|

| | | |
|-----------|---|-----------|
| | Guarantee Fund, PMEGP, discussions, group exercises etc | |
| V | Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing | 08 |
| VI | Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business | 05 |

Outcomes:

Students will be able to...

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Assessment

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only four questions need to be solved.

References:

1. Poornima Charantimath, Entrepreneurship development-Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, latest edition, The McGraw Hill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New Century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lal, Shikha Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium Enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship-Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msme training.gov.in

| SemesterII | | |
|-------------|---|---------|
| Course Code | Course Name | Credits |
| STRIE2024 | InstitutelevelElective: HumanResourceManagement | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | Total Marks |
|--------------------|-------|-------------|----------------|------------------------------|-------------------------|----|----|----------------|
| InternalAssessment | | | EndSem Exam | Durationof End SemExam | TW | PR | OR | |
| Test1 | Test2 | Averag e | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management.
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

| Module | Detailed Contents | Hrs |
|--------|---|-----|
| I | Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues. | 5 |
| II | Organizational Behavior (OB) Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study | 7 |
| III | Organizational Structure & Design Structure, size, technology, Environment of organization; Organizational Roles & | 6 |

| | | |
|----|---|----|
| | <p>conflicts:Conceptofroles;roledynamics;roleconflictsandstress.</p> <p>Leadership:Conceptsandskillsofleadership,Leadershipandmanagerialroles,Leadership styles andcontemporaryissues in leadership.</p> <p>PowerandPolitics:Sourcesandusesofpower;Politicsatworkplace,Tacticsandstrategies.</p> | |
| IV | <p>HumanresourcePlanning</p> <p>Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction,employeemorale.</p> <p>PerformanceAppraisalSystems:Traditional&modernmethods,PerformanceCounseling,Career Planning.</p> <p>Training&Development:IdentificationofTrainingNeeds,TrainingMethods</p> | 5 |
| V | <p>EmergingTrendsin HR</p> <p>Organizational development; Business Process Re-engineering (BPR),BPR as atool for organizational development, managing processes & transformation in HR.OrganizationalChange,Culture, Environment</p> <p>Cross Cultural Leadership and Decision Making: Cross Cultural Communicationanddiversityatwork,causesofdiversity,managingdiversitywithspecial referencetohandicapped,womenandageingpeople,intracompanyculturaldifferencein employeemotivation.</p> | 6 |
| VI | <p>HR&MIS</p> <p>Need, purpose, objective and role of information system in HR, Applications inHRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals,Hotelsand serviceindustries</p> <p>StrategicHRM</p> <p>RoleofStrategicHRMinthemarketbusinessworld,ConceptofStrategy,StrategicManagementProcess,ApproachestoStrategicDecisionMaking;StrategicIntent–Corporate Mission, Vision,Objectives andGoals</p> <p>LaborLaws&IndustrialRelations</p> <p>Evolution of IR, IR issues in organizations, Overview of Labor Laws in India;IndustrialDisputes Act,TradeUnionsAct, Shops andEstablishments Act</p> | 10 |

ContributiontoOutcomes:

Studentswill beable to:

- Understandthe concepts,aspects,techniquesand practicesofthehumanresourcemanagement.
- UnderstandtheHumanresourcemanagement(HRM)processes,functions,changesandchallengesin today'semergingorganizational perspective.
- Gainknowledge aboutthelatestdevelopmentsandtrends inHRM.
- Applytheknowledgeofbehavioralskillslearntandintegrateitwithininterpersonalandintergroupenvironment emergingas futurestableengineersand managers.

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstestandtheotheriseitheraclasstest or assignment on liveproblems or course project.

EndSemesterTheoryExamination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in questionpapers of end semester examination. **In question paper weightage of each module will be proportional tonumberofrespectivelecturehours asmentionin thesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestion carryequalmarks
3. Questionswillbemixedinnature(forexamplesupposedQ.2haspart(a)frommodule3thenpart (b)will befrom anymodule other than module3)
4. OnlyFour questionneedto besolved.

References:

1. StephenRobbins,OrganizationalBehavior,16th Ed,2013
2. VS P Rao, Human ResourceManagement, 3rd Ed, 2010, Excelpublishing
3. Aswathapa,Humanresourcemanagement:Text&cases,6th edition, 2011
4. C. B.MamoriaandSVGankar,Dynamics ofIndustrialRelationsinIndia,15thEd, 2015,HimalayaPublishing,15thedition, 2015
5. P.SubbaRao,EssentialsofHumanResourcemanagementandIndustrialrelations,5thEd,2013,Himalaya Publishing
6. LaurieMullins,Management&OrganizationalBehavior, LatestEd,2016,PearsonPublications

| SemesterII | | |
|-------------|---|---------|
| Course Code | Course Name | Credits |
| STRIE2025 | InstitutelevelElective:ProfessionalEthicsandCSR | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | Total Marks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|----------------|
| InternalAssessment | | | End SemEx am | Durationof End SemExam | TW | PR | OR | |
| Test 1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- Tounderstandprofessionalethics inbusiness
- Torecognizedcorporate socialresponsibility

| Module | DetailedContents | Hrs |
|--------|--|-----|
| 01 | Professional Ethics and Business: The Nature of Business Ethics; EthicalIssuesinBusiness; MoralResponsibilityandBlame;Utilitarianism:Weighing SocialCostsandBenefits;Rightsand DutiesofBusiness | 04 |
| 02 | ProfessionalEthicsintheMarketplace: PerfectCompetition;MonopolyCompet ition; Oligopolistic Competition; Oligopolies and Public Policy ProfessionalEthicsandtheEnvironment: DimensionsofPollutionandRe sourceDepletion;EthicsofPollutionControl;EthicsofConserving DepletableResources | 08 |
| 03 | ProfessionalEthicsofConsumerProtection: MarketsandConsumerProtection; Contract View of Business Firm's Duties to Consumers; Due CareTheory;AdvertisingEthics; Consumer Privacy ProfessionalEthicsofJobDiscrimination: NatureofJobDiscrimination; ExtentofDiscrimination;Reservation ofJobs. | 06 |
| 04 | IntroductiontoCorporateSocialResponsibility: PotentialBusinessBenefits— Triplebottomline,Humanresources,Riskmanagement,Supplierrelations;Criticisms andconcerns—Nature ofbusiness;Motives; Misdirection. TrajectoryofCorporateSocialResponsibilityinIndia | 05 |
| 05 | Corporate Social Responsibility: Articulation of Gandhian TrusteeshipCorporateSocialResponsibilityandSmallandMediumEnterprises(SME s)in India,CorporateSocialResponsibilityandPublic-PrivatePartnership(PPP) | 08 |

| | | |
|----|---|----|
| 06 | Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013. | 08 |
|----|---|----|

Contribution to outcomes

Students will be able to...

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only four questions need to be solved.

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

| SemesterII | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRIE2026 | InstitutelevelElective:ResearchMethodology | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | Total Marks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|----------------|
| InternalAssessment | | | End SemEx am | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- TounderstandResearch andResearchProcess
- Toacquaintstudentswithidentifyingproblemsforresearchanddevelopresearchstrategies
- Tofamiliarizestudentswiththetechniquesofdatacollection,analysisofdataandinterpretation

| Module | DetailedContents | Hrs |
|--------|---|-----|
| 01 | IntroductionandBasicResearchConcepts 1.1 Research– Definition;ConceptofConstruct,Postulate,Proposition,Thesis,Hypothesis,Law, Principle.Research methods vsMethodology 1.2 NeedofResearchinBusinessandSocialSciences 1.3 ObjectivesofResearch 1.4 IssuesandProblemsinResearch 1.5 CharacteristicsofResearch: Systematic, Valid, Verifiable, EmpiricalandCritical | 09 |
| 02 | TypesofResearch 2.1. BasicResearch 2.2. AppliedResearch 2.3. DescriptiveResearch 2.4. Analytical Research 2.5. EmpiricalResearch 2.6 QualitativeandQuantitativeApproaches | 07 |
| 03 | ResearchDesignandSampleDesign 3.1 Research Design–Meaning,TypesandSignificance 3.2 SampleDesign–MeaningandSignificanceEssentialsofagoodsamplingStagesin SampleDesignSamplingmethods/techniques SamplingErrors | 07 |
| 04 | Research Methodology 4.1 Meaningof ResearchMethodology 4.2. StagesinScientificResearchProcess: | 08 |

| | | |
|-----------|--|-----------|
| | a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report | |
| 05 | Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis | 04 |
| 06 | Outcome of Research 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation | 04 |

Outcomes

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total six questions
2. All questions carry equal marks
3. Questions will be mixed in nature (for example, suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only four questions need to be solved.

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBSPublishers Distributors.
2. Kothari, C.R., 1985, Research Methodology- Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology- A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

| SemesterII | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRIE2027 | InstitutelevelElective:IPRandPatenting | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | Total Marks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|----------------|
| InternalAssessment | | | End Sem Exam | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquainted with Patent search and patent filing procedure and applications

| Module | DetailedContents | Hr |
|--------|--|----|
| 01 | Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development | 05 |
| 02 | Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc. | 07 |
| 03 | Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc. | 05 |
| 04 | Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification | 07 |

| | | |
|----|--|----|
| | Patentclaims,Disclosuresandnon-disclosures,Patentrightsandinfringement, Methodofgetting apatent | |
| 05 | PatentRules: Indianpatentact,Europeanscenario,USscenario,Australia scenario,Japanscenario,Chinesescenario,Multilateral treatieswhereIndiaisamember(T RIPS agreement, Paris convention etc.) | 08 |
| 06 | Procedure for Filing a Patent (National and International): Legislation andSalient Features, Patent Search, Drafting and Filing Patent Applications, Processingof patent, Patent Litigation, Patent Publication etc, Time frame and cost, PatentLicensing,PatentInfringement Patentdatabases: Importantwebsites,Searchinginternationaldatabases | 07 |

Outcomes:

Studentswillbeable to...

- understand IntellectualPropertyassets
- assistindividuals andorganizationsin capacitybuilding
- workfor development,promotion,protection,compliance,andenforcementofIntellectualPropertyandPatent ing

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstestandtheotheriseitheraclasstest or at least 6 assignment on completesyllabus or courseproject.

EndSemesterTheoryExamination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in questionpapers of end semester examination. **In question paper weightage of each module will be proportional tonumberofrespectivelecturehours asmentionin thesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestion carryequalmarks
3. Questionswillbemixedinnature(forexamplesupposedQ.2haspart(a)frommodule3thenpart (b)will befrom anymodule other than module3)
4. OnlyFourquestion needtobe solved.

ReferenceBooks:

1. RajkumarS.Adukia,2007,AHandbookonLawsRelatingtoIntellectualPropertyRightsinIndia,TheInstitu teof Chartered Accountants ofIndia
2. KeaylaBK,Patentsystemandrelatedissuesataglance,PublishedbyNationalWorkingGrouponPatentLaw s
3. TSengupta,2011,IntellectualPropertyLawinIndia,KluwerLawInternational
4. TzenWongandGrahamDutfield,2010,IntellectualPropertyandHumanDevelopment:CurrentTrendsand FutureScenario, CambridgeUniversityPress
5. Cornish,WilliamRodolph&Llewelyn,David.2010,IntellectualProperty:Patents,Copyrights,TradeMar ks and AlliedRight, 7thEdition,Sweet &Maxwell
6. LousHarns,2012,TheenforcementofIntellactualPropertyRights:ACaseBook,3rdEdition,WIPO
7. PrabhuddhaGanguli,2012,IntellectualPropertyRights,1stEdition,TMH
8. RRadhaKrishnan &SBalasubramanian,2012,IntellectualPropertyRights,1stEdition,ExcelBooks

9. MAshokKumarandmohdIqbalAli,2-11,IntellectualPropertyRights,2ndEdition,SerialPublications
10. KompalBansalandPraishitBansal,2012,Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITSPilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, WorldScientificPublishingCompany
13. NSRathore, SMMathur, PritiMathur, AnshulRathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, NewIndia PublishingAgency
14. VivienIrish, 2005, IntellectualPropertyRightsforEngineers, IET
15. HowardB Rockman, 2004, IntellectualPropertyLawfor Engineers and scientists, Wiley-IEEE Press

| SemesterII | | |
|-------------|--|---------|
| Course Code | Course Name | Credits |
| STRIE2028 | InstitutelevelElective:DigitalBusinessManagement | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End SemEx am | Durationof EndSem Exam | TW | PR | OR | |
| Test 1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

| Module | Detailedcontent | Hrs |
|--------|--|-----|
| 1 | Introduction to Digital Business- Introduction, Background and current status, E-marketplaces, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services) Opportunities and Challenges in Digital Business, | 09 |
| 2 | Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC | 06 |
| 3 | Digital Business Support services: ERP as e-business backbone, knowledge Top Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure | 06 |

| | | |
|---|--|----|
| 4 | Managing E-Business- Managing Knowledge,Management skills for e-business,ManagingRisks in e-business SecurityThreatstoe-business- SecurityOverview,ElectronicCommerceThreats,Encryption,Cryptography,PublicKeya ndPrivateKeyCryptography,Digital | 06 |
|---|--|----|

| | | |
|---|---|----|
| | Signatures,DigitalCertificates,SecurityProtocolsover PublicNetworks:HTTP,SSL,FirewallasSecurityControl,PublicKeyInfrastructure(PKI)fo rSecurity,Prominent CryptographicApplications | |
| 5 | E-BusinessStrategy -E-businessStrategicformulation-AnalysisofCompany's Internaland externalenvironment,Selectionofstrategy, E-business strategy into Action, challenges and E- Transition(Processof Digital Transformation) | 04 |
| 6 | Materializinge-business:FromIdeatoRealization -Businessplanpreparation CaseStudiesandpresentations | 08 |

Outcomes:

Studentswill be ableto:

- Identifydriversofdigitalbusiness
- Illustratevariousapproachesandtechniques forE-businessandmanagement
- PrepareE-businessplan

Assessment:

Internal:

Assessmentconsistsoftwotestsoutofwhich;oneshouldbecompulsoryclasstestandtheotheriseitheraclasstest or at least 6 assignment on completesyllabus or courseproject.

EndSemesterTheoryExamination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in questionpapers of end semester examination. **In question paper weightage of each module will be proportional tonumberofrespectivelecturehours asmentioninthesyllabus.**

1. Questionpaperwillcompriseoftotalsixquestion
2. Allquestion carryequalmarks
3. Questionswillbemixedinnature(forexamplesupposedQ.2haspart(a)frommodule3thenpart
(b)will befrom anymodule other than module3)
4. OnlyFour questionneedto besolved.

References:

1. A textbook on E-commerce, ErArunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors,2011
2. E-commercefromvisiontofulfilment, EliasM.Awad,PHI-Restricted,2002
3. DigitalBusinessandE-CommerceManagement,6th Ed,DaveChaffey,Pearson,August2014
4. IntroductiontoE-business-ManagementandStrategy,ColinCombe,ELSVIER,2006
5. DigitalBusinessConceptsandStrategy,EloiseCoupey, 2nd Edition,Pearson
6. TrendandChallengesinDigitalBusiness Innovation,VinocenzoMorabito,Springer
7. DigitalBusinessDiscourseErikaDarics,April2015,PalgraveMacmillan
8. E-Governance-
ChallengesandOpportunitiesin:Proceedingsin2ndInternationalConferencetheoryandpracticeof
ElectronicGovernance
9. PerspectivestheDigitalEnterprise–AframeworkforTransformation,TCSconsultingjournalVol.5
10. MeasuringDigitalEconomy-Anewperspective-DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en)OECDPublishing

| SemesterII | | |
|------------|--|---------|
| CourseCode | CourseName | Credits |
| STRIE2029 | InstitutelevelElective: Environmental Management | 03 |

TeachingScheme

| ContactHours | | | CreditsAssigned | | | |
|--------------|-----------|----------|-----------------|-----------|----------|-------|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

EvaluationScheme

| Theory | | | | | Termwork/Practical/Oral | | | TotalMarks |
|--------------------|-------|---------|--------------------|------------------------------|-------------------------|----|----|------------|
| InternalAssessment | | | End SemEx am | Durationof EndSem Exam | TW | PR | OR | |
| Test1 | Test2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03Hrs. | -- | -- | -- | 100 |

Objectives:

- Understandandidentifyenvironmentalissuesrelevantto India and globalconcerns
- Learnconceptsofecology
- Familiarizeenvironmentrelatedlegislations

| Module | DetailedContents | Hrs |
|--------|---|-----|
| I | Introduction and Definition of Environment: Significance of EnvironmentManagementfor contemporarymanagers, Careeropportunities. EnvironmentalissuesrelevanttoIndia,SustainableDevelopment,TheEnergy scenario. | 10 |
| II | GlobalEnvironmentalconcerns:GlobalWarming,AcidRain,OzoneDepletion,Hazardous Wastes, Endangered life-species, Loss of Biodiversity,Industrial/Man-madedisasters, Atomic/Biomedical hazards, etc. | 06 |
| III | ConceptsofEcology:Ecosystemsandinterdependencebetweenlivingorganisms, habitats,limitingfactors,carryingcapacity,foodchain,etc. | 05 |
| IV | ScopeofEnvironmentManagement,Role&functionsofGovernmentasaplanningandregul atingagency. EnvironmentQualityManagement andCorporateEnvironmental Responsibility | 10 |
| V | TotalQualityEnvironmentalManagement,ISO-14000,EMScertification. | 05 |
| VI | General overview of major legislations like Environment Protection Act, Air (P &CP) Act, Water (P & CP) Act, Wildlife Protection Act,Forest Act, Factories Act,etc. | 03 |

ContributiontoOutcomes

Studentswillbeable to...

- Understandthe conceptofenvironmentalmanagement
- Understandecosystemandinterdependence,foodchainetc.
- Understandandinterpret environmentrelatedlegislations

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

5. Question paper will comprise of total six questions
6. All questions carry equal marks
7. Questions will be mixed in nature (for example, supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
8. Only four questions need to be solved.

References:

1. Environmental Management: Principles and Practice, C.J. Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, T. V. Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems—Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S.N. Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K. Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015

| Semester II | | |
|-------------|----------------|---------|
| Course Code | Course Name | Credits |
| STRL201 | Program Lab-II | 01 |

| Teaching Scheme | | | | | | |
|-----------------|-----------|----------|------------------|-----------|----------|-------|
| Contact Hours | | | Credits Assigned | | | |
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 2 | - | - | 1 | - | 01 |

| Evaluation Scheme | | | | | | | | |
|---------------------|--------|---------|--------------|--------------------------|---------------------------|----|----|-------|
| Theory | | | | | Term Work/ Practical/Oral | | | Total |
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| - | - | - | - | - | 25 | - | 25 | 50 |

| Objectives | |
|--|--|
| <ul style="list-style-type: none"> • Apply spreadsheet (excel or other) tools to simplify complex civil engineering problems • Study of the Software used for analysis and design of structures • Write technical papers in reputed journals • Summarizes technical articles | |

| Detailed Syllabus | | |
|-------------------|--|-----|
| Module | Course Module / Contents | Hrs |
| I | Material testing laboratory: Revision of Tests on Cement, Aggregates, Fresh concrete, Destructive / Non-destructive Tests related with determination of various material properties related with construction. | 04 |
| II | Computer applications Basic fundamentals of coding, Application of EXCEL spreadsheets in analysis of structural members. Use of various software available for Analysis and Design of Structures. (SAP/ ANSYS/ ETABS/ STAAD Pro) is recommended. | 04 |
| III | The analysis and design of the structures containing anyone of building (G+2) or bridges or industrial truss or transmission tower. The comprehensive report of the analysis and design of the selected structure. | 08 |
| IV | Summarizing two articles related to Structural engineering from reputed technical journals | 04 |

| Contribution to Outcomes |
|---|
| <p>Students will be able to:</p> <ul style="list-style-type: none"> • understand the physics of the problem • understand codal provisions and its applications. • learn various software in Analysis and design of structures. • be familiar with hands on practice. • apply spreadsheet (excel or other) tools to simplify complex civil engineering problems |

| Semester II | | |
|-------------|--------------------|---------|
| Course Code | Course Name | Credits |
| STRSBL201 | Skill Based Lab-II | 02 |

| Teaching Scheme | | | | | | |
|-----------------|-----------|----------|------------------|-----------|----------|-------|
| Contact Hours | | | Credits Assigned | | | |
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 4 | - | - | 2 | - | 02 |

| Evaluation Scheme | | | | | | | | |
|---------------------|--------|---------|--------------|--------------------------|------------------------------|----|----|-------|
| Theory | | | | | Term Work/ Practical/Oral | | | Total |
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| - | - | - | - | - | 50 | - | 50 | 100 |

| Course Objectives | |
|--|--|
| <ul style="list-style-type: none"> Understand the Concept of coding algorithm. Study the Various Structural Analysis and Design Software used in Construction Industry | |

| Detailed Syllabus | | |
|--|---|------|
| Module | Course Module / Contents | Hrs. |
| I | Learners should be asked to develop the Finite Element program for analyzing structural members like beams, columns, slabs, trusses, frames etc | 09 |
| II | Learners should be asked to analyze and design some of the structures involved in the courses they studied and submit the report. | 11 |
| Term Work: At least one Project Assignment must be prepared in mention software of each module required to Submit for Term work Assessment & Viva Exam. | | |

| Contribution to Outcomes | |
|---|--|
| Students will be able to: <ul style="list-style-type: none"> Basic concepts of developing the coding algorithm. Use the analysis and design software. | |

Recommended Books & Journal

- 1) All reputed National/international Structural Engineering Journals
- 2) Available analysis and design software