Department of Civil Engineering

1.	MAN-001	Mathematics-1	BSC	4
2.	PHN-001	Mechanics	BSC	4
3.	CEN-105	Introduction to Environmental Studies	GSC	3
4.	HS-001A	Communication Skills (Basic)	HSSC	2
5.	HS-001B	Communication Skills (Advance)	HSSC	2
6.	HSN-002	Ethics and General Awareness	HSSC	2
7.	CEN-101	Introduction to Civil Engineering	DCC	2
8.	CEN-103	Numerical Methods and Computer Programming	ESC	4
9.	CYN-008	General Chemistry-III	BSC	4
10.	MAN-006	Probability and Statistics	BSC	4
11.	CEN-102	Solid Mechanics	ESC	4
12.	CEN-104	Water Supply Engineering	DCC	4
13.	CEN-106	Geomatics Engineering – I	DCC	4
14.	CEN-108	Fluid Mechanics	DCC	4
15.	EEN-112	Electrical Science	ESC	4
16.	MIN-102	Basic Manufacturing Processes	ESC	4
17.	CEN-291	Engineering Graphics	DCC/ESC	4
18.	CEN-391	Design of Reinforced Concrete Elements	ESC	4
19.	CEN-203	Geomatics Engineering II	DCC	5
20.	CEN-205	Channel Hydraulics	DCC	4
21.	CEN-207	Structural Analysis-I	DCC	4
22.	CEN-202	Waste Water Engineering	DCC	4
23.	CEN-206	Structural Analysis-II	DCC	4
24.	CEN-208	Design of Reinforced Concrete Elements	DCC	4
25.	CEN-210	Highway and Traffic Engineering	DCC	4

26.	CEN-303	Soil Mechanics	DCC	4
27.	CEN-305	Design of Steel Elements	DCC	4
28.	CEN-307	Railway Engineering and Airport Planning	DCC	4
29.	CEN-306	Foundation Engineering	DCC	4
30.	CEN-308	Design of Structural Systems	DCC	5

Department: Department of Civil Engineering
Department Elective Courses : Category I

1.	CEN-411 *	Construction Planning and Management		
2.	CEN-614*	Theory and Application of GIS		
3.	CEN-412	Water Recourses Engineering		
4.	CEN-413 *	Building material and Construction Technology		
5.	CEN-414 *	System Analysis		

Department Elective Courses : Category I
Stream 1

1.	CEN-544*	Structural Dynamics		
2.	CEN-543*	Advance Concrete Design		
3.	CEN-501*	Environment Modelling and Simulation		
4.	CEN-421*	Advanced Water and Wastewater Treatment		
5.	CEN-422*	Dam Engineering		
6.	CEN-514*	Geodesy and GPS Surveying		
7.	CEN-642*	Analysis and Design of Bridges		
8.	CEN-545*	Finite Element Methods		
9.	CEN-601*	Air Pollution and Control		
10.	CEN-605*	Solid Waste Management		
11.	CEN-423*	Ground Water Hydrology		
12.	CEN-636*	Hydropower Engineering		
13.	CEN-424*	Digital Image Processing		

Stream 2

1.	CEN-544 *	Structural Dynamics		
2.	CEN-543 *	Advanced Concrete Design		
3.	CEN-625 *	Ground Improvement Design		
4.	CEN-524*	Soil Dynamics and Machine Foundations		
5.	CEN-431 *	Advanced Highway Engineering		
6.	CEN-564 *	Geometric Design		
7.	CEN-514 *	Geodesy and GPS Surveying		
8.	CEN-642 *	Analysis and Design of Bridges		
9.	CEN-545 *	Finite Element Methods		
10.	CEN-433 *	Rock Engineering		
11.	CEN-434 *	Traffic Engineering and management		
12.	CEN-424 *	Digital Image Processing		

Open Elective Courses

1.	CEN-333*	Probability Methods in Engineering Problems		

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE:　　　**DEPARTMENT OF CIVIL ENGINEERING**

1. Subject code:　**CEN-101**　　　　　Course Title: **Introduction to Civil Engineering**

2. Contact Hours: **L: 2　　T: 0　　P: 0**

3. Examination Duration (Hrs): **Theory:**　0　**Practical:**　0

4. Relative Weightage: **CWS:**　0　**PRS:**　0　**MTE:**　0　**ETE:**　100　**RE:**　0

5. Credits:　2　　　　6. Semester: **Autumn**　7. Subject Area: **DCC**

8. Pre-requisite: **Nil**

9. Objective: To introduce the Civil Engineering profession and the ethical responsibilities of engineering practice.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Structural E ngineering:** Introduction to various aspects associated with analysis and design of various structural systems, Buildings, Bridges and other infrastructure projects.	8
2.	**Hydraulics/Water R esources E ngineering:** Hydrological cycle, Flows in pipes and channels, Reservoirs/Dams, Hydro-power	5
3.	**Geotechnical E ngineering:** Soil as construction material, Problems in plain and hilly areas, Earth retaining structures, Foundations for different types of structures, Embankments/ levees/earth and rockfill dams, Ground improvement techniques, Underground structures like tunnels, Shafts and caverns, Slopes engineering	3
4.	**Transportation Engineering:** Fields of Transportation Engineering, Transportation Systems – Their suitability and utility, Transportation problems and roles of traffic engineers and transportation planners; Types of pavements, Pavement materials – conventional and new materials, Structure of a pavement, Airfield pavement.	4
5.	**Environmental E ngineering:** Infrastructure required for water and wastewater engineering	4
6.	**Geomatics Engineering:** Importance of surveying in Civil Engineering, Types of maps, Satellite images and aerial photographs, GPS survey, 3-D modeling, GIS applications in Civil Engineering projects	4
Total		**28**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Penn M. R. and Parker P. J. "Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering" John Wiley & Sons	2011
2.	Mckay W. B. " Building Construction" Orient Longman	2003
3.	Schodek D. L."Structures" Prentice Hall of India Pvt. Ltd.	2002

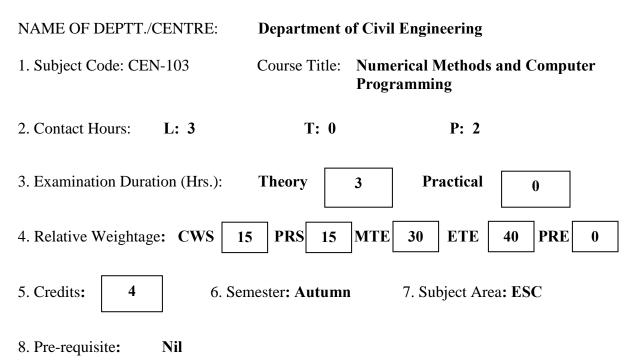# INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **Department of Civil Engineering**

1. Subject code: **CEN-102**   Course Title: **Solid Mechanics**

2. Contact Hours: **L: 3**   **T: 1**   **P: 0**

3. Examination Duration (Hrs):   **Theory: 3   Practical: 0**

4. Relative Weightage: **CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0**

5. Credits: 4   6. Semester: **Spring**   7. Subject Area: **ESC**

8. Pre-requisite: **Nil**

9. Objective : To introduce the concepts of equilibrium and deformation in components, and structures for engineering design.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Analysis of Stresses and Strains :** Concept of stress, normal stress and shear stress, nine Cartesian components of stress at a point, sign convention and notation, equality of shear stresses on mutually perpendicular planes and their planes of action, stress circle; Concept of strain, normal and shear strain, two dimensional state of strain, Poisson's ratio, volumetric strain, strain circle, Concept of strain energy	**08**
2.	**Stress-Strain Relationships :** Hooke's law and its application to isotropic materials, elastic constants and their relationships, plane stress and plain strain conditions.	**02**
3.	**Mechanical Properties :** Uniaxial tension test to determine yield and ultimate strength of materials, stress-strain diagram, proof stress, ductile and brittle materials, hardness and impact strength; Conditions affecting mechanical behaviour of engineering materials	**02**
4.	**Members in Uniaxial State of Stress :** Uniform cross-section and tapered bars subjected to uniaxial tension and compression, composite bars and statically indeterminate bars, thermal stresses; Introduction to plasticity; S.E. under axial loading.	**04**
5.	**Members Subjected to Axi-Symmetric Loads :** Stresses and strains in thin cylindrical shells and spheres under internal pressure, stresses in thin rotating rings.	**02**
6.	**Members Subjected to Torsional Loads :** Torsion of solid and hollow circular shafts, stepped and composting shafts, close-coiled helical springs subjected to axial loads, S.E. in	**02**

	torsion.	
7.	**Members S ubjected t o Flexural L oads :** Statically determinate beams, support reactions, relationship between load, shear force and bending moment, shear force and bending moment diagrams; Theory of flexure for initially straight beams, distribution of bending stresses across the beam cross-section, principal stresses in beams; Equation of elastic curve for the loaded beam, relationship between bending moment, slope and deflection; Calculation of deflection by integration, moment area and unit-load methods, S.E. in flexure.	**15**
8.	**Members Subj ected t o Combined L oads :** Short struts subjected to eccentric loads, shafts subjected to combined bending, torsion and axial thrust, concept of theory of failure.	**02**
9.	**Elastic S tability of C olumns :** Euler's theory of initially straight columns, critical loads for different end condition of columns, eccentric loading, columns with small initial curvature, empirical formulae.	**02**
10.	**Stresses i n B eams (Advance T opics) :** Composite beams, Transformed section method, Bending of unsymmetric beams, The shear-center concept.	**03**
	TOTAL	**42**

11.   Suggested Books :

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Gere, J.M. and Goodno, B.J., "Strength of Materials", Indian Edition (4th reprint), Cengage Learning India Private Ltd.	2009
2.	Beer, F.P., Johuston, Jr., E.R., Dewolf, J.T. and Mazureu, D.E., "Mechanics of Materials", Fifth Edition, McGraw Hill.	2009
3.	Hibbeler, R.C., "Mechanics of Materials", Sixth Edition, Pearson.	2005
4.	Crandall, S.H., Dahl, N.C. and Lardner, T.J., "An Introduction to the Mechanics of Solids", 2nd Edition, McGraw Hill.	1999
5.	Timoshenko, S.P. and Young, D.H., "Elements of Strength of Materials", Fifth Edition, (In MKS Units), East-West Press Pvt. Ltd.	2009 (reprint)

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: CEN-103   Course Title: **Numerical Methods and Computer Programming**

2. Contact Hours: **L: 3**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.):   **Theory**   **3**   **Practical**   **0**

4. Relative Weightage**: CWS** **15** **PRS** **15** **MTE** **30** **ETE** **40** **PRE** **0**

5. Credits**:**   **4**   6. Semester**: Autumn**   7. Subject Area**: ESC**

8. Pre-requisite**:**   **Nil**

9. Objective: To introduce fundamentals of a higher level programming language, various numerical methods and their application to engineering problems.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction of a higher level programming language, Number system, Introduction to C++, Tokens, Expressions and control structures, Functions, Classes and objects, Constructors and destructors, Operator overloading, Inheritance: extending classes, Virtual functions and polymorphism, Working with files, Manipulating strings	**16**
2.	Error analysis: Accuracy and precision, Absolute and relative errors, measurement and computational errors	**2**
3.	Numerical interpolation: Lagrange interpolation, Hermite Interpolation;	**2**
4.	Numerical differentiation and integration: Newton cotes, Gaussian quadrature	**6**
5.	Numerical solution of non linear equation: Newton – Raphson's method, Secant method, Method of false positions	**2**
6.	Numerical solution of simultaneous linear equations: Solution of large system of simultaneous equations, Direct and iterative algorithms based on Gauss elimination for symmetric and un-symmetric banded equations	**5**
7.	Eigen value problems: Estimation and solution methods for eigen	**3**

	value problems	
8.	Numerical solution of ordinary and partial differential equations, FDM, Stability and Convergence	**6**
	Total	**42**

11. List of Practical's:

1. Preliminary programming for developing simple mathematical algorithms for problems like arranging a given series in either ascending and descending order, summation of series, etc.
2. Development of programmes for interpolation methods and numerical integration techniques.
3. Development of algorithms and programme for a solution of linear simultaneous linear equation systems, non-linear equations, etc.
4. Development of algorithm and programme for solving an eigen value problem as applied to vibration problems, etc.
5. Development of computer programme for finite difference solution for problems like heat conduction, seepage through foundations, electrical potential distribution, etc.

12. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Dietel H. M. and Dietel P. J., "C++ How to Programme", Prentice Hall	**2011**
2.	Grewal B. S., "Numerical Methods in Engineering and Science, (with programming in C and C++)", Khanna Publishers	**2012**
3.	Gerald, F.C. and Wheatley, P.O., " Applied Numerical Analysis", Pearson Education Inc.	**2008**
4.	Chapra, S.C. and Canale, R. P., " Numerical Methods for Engineers", Tata McGraw-Hill	**2005**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-104**   Course Title: **Water Supply Engineering**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory : 3**   **Practical: 0**

4. Relative Weightage**: CWS: 15   PRS: 15   MTE: 20   ETE: 50   PRE: 0**

5. Credits**: 4**   6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To impart knowledge of various aspects related to supply of pure and safe drinking water to communities and the conservation of water.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction and scope, source of water supply: ground and surface water, water quality : physical, chemical and biological characteristics, water demand, per capita supply, population forecasting	**6**
2.	Groundwater: Groundwater flow, well hydraulics, saltwater intrusion, groundwater recharge, rainwater harvesting	**4**
3.	Water collection and treatment, conventional treatment; flowsheets, Flow measurement, screen, settling, coagulation-flocculation, filtration, Water softening- Lime soda and Ion exchange, disinfection- Chlorination, ozonation, UV, Disinfection byproducts, design of facilities.	**14**
4.	Water distribution, pumping systems, storage reservoirs, distribution networks, water pipes, economic sizing of pipes, valves and other appurtenances, water hammer, water leakage, corrosion and corrosion control	**14**
5.	Water supply in building, plumbing and fixtures.	**2**
6.	Small water supply systems.	**2**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Hammer, M.J. and Hammer, M.J., "Water and Wastewater Technology", 6th Ed., Prentice Hall of India.	2008
2.	Davis, M.L. and Cornwell, D.A., "Introduction to Environmental Engineering", 4th ed. McGraw Hill.	2008
3.	Ronald Droste., "Theory and Practice of Water and Wastewater Treatment", John Wiley & Sonc	2005
4.	McGhee, T.J., "Water Supply and Sewerage", McGraw Hill.	1991
5.	Peavy, H.S., Rowe, D.R. and Tchobanoglous, G., "Environmental Engineering", McGraw Hill.	1986
6.	CPHEEO, Manual on Water Supply and Treatment- Third edition, Ministry of Urban Development, Gov. of India	1999

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **DEPARTMENT OF CIVIL ENGINEERING**

1. Subject code: **CEN-105**   Course Title: **Introduction to Environmental Science**

2. Contact Hours: **L: 3   T: 0   P: 0**

3. Examination Duration (Hrs): **Theory:**   3   **Practical:**   0

4. Relative Weightage: **CWS:**   15   **PRS:**   0   **MTE:**   35   **ETE:**   50   **PRE:**   0

5. Credits: 3   6. Semester: **Autumn**   7. Subject Area: **GSC**

8. Pre-requisite: **Nil**

9. Objective: To introduce fundamentals of environmental pollution and its control.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Overview: Environment and Natural Processes; Development (Resource Utilization & Waste Generation); Environmental issues; Concept of Sustainable Development; Issues affecting future development (population, urbanization, health, water scarcity, energy, climate change, toxic chemicals, finite resources etc.); Environmental units	6
2.	Air –Water interaction: (Liquid phase-gas phase equilibrium) Henry's Law Constant with units, Dimensionless Henry's Law Constant	3
3.	Water –Soil Interaction: Carbonate System (Alkalinity and buffering capacity); Major ions in water; Natural Organic Matter (NOMs); Water quality parameters; Physical processes (Mass Balance): Spatio-temporal variation in quality of river water, lake water, ground water; Water quality standards	9
4.	Wetlands, water treatment and wastewater treatment .	6
5.	Air resources: Atmosphere; Air pollutants; Emissions and control of air pollutants; Atmospheric meteorology and dispersion; Transport of air (global, regional, local); Air/ atmospheric stability; Plume shape; Gaussian modeling; Air quality standards	9
6.	Land pollution and solid waste management	3
7.	Ecosystem: Structure and function; Energy flow in ecosystem; Material flow in ecosystem; Biodiversity and ecosystem health; Bio-amplification and bio-magnification	3
8.	Hazardous Waste: Definition; Classification; Storage and management; Site remediation; Environmental Risk: assessment, and management	3
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e	2008
2.	Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e	2007
3.	Peavy H. S., Rowe D.R. and Tchobanoglous G., "Environmental Engineering", McGraw Hill, New York	1986
4.	Mines R. O. and Lackey L. W. ""Introduction to Environmental Engineering", Prentice Hall, New Yark	2009
5.	Miheicic J. R. and Zimmerman J. B. " Environmental Engineering: Fundamentals, Sustainability, Design" John Wiley and Sons, Inc.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-106**   Course Title: **Geomatics Engineering – I**

2. Contact Hours: **L: 3**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.):   **Theory : 3**   **Practical: 0**

4. Relative Weightage**: CWS:0   PRS: 25   MTE: 25   ETE: 50   PRE: 0**

5. Credits**: 4**   6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To impart knowledge about basic principles of field surveying procedures and practices for civil engineering applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Importance of Geomatics engineering and its relevance to engineering projects, basic principles. Classification of surveys based on instrument and work.	2
2.	Type of maps, scales and uses, plotting accuracy, map sheet numbering, coordinate and map projection.	4
3.	Surveying equipment, levels, compass, theodolites, tachometer, EDM, total Stations, GPS and Laser based instruments.	5
4.	Measurement of angles, directions and distance.	6
5.	Determination of elevation, spirit leveling, trigonometrical leveling, and tachometric surveying, contouring.	8
6.	GPS surveying - principles and methods, DGPS, error in observations and corrections, Mapping with GPS	6
7.	Methods of control establishment, traversing, triangulation, trilateration, adjustment of survey measurements, computation of coordinates.	5
8.	Plane table surveys and mapping, curve layout	6
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Anderson, J.M. and Mikhail, E.M., "Surveying: Theory and Practice", McGraw Hill.	1998
2.	Arora, K.R., "Surveying", Vol. I, II and III, Standard Book House.	1995
3.	Chandra, A.M., "Surveying", New Age Publishers.	2002
4.	Schofield, W. and Breach M., "Engineering Surveying", 6th Ed., Butterworth-Heineman.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-108**   Course Title: **Fluid Mechanics**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory: 3**   **Practical: 0**

4. Relative Weightage**: CWS: 15   PRS: 15   MTE: 20   ETE: 50   PRE: 0**

5. Credits**: 4**   6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To introduce fundamentals of stagnant, flowing fluid and flow through different conduits.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Fluid properties, types of fluids, continuum principle	3
2.	**Principles of Fluid S tatics:** Basic equations, manometers, hydrostatic forces on submerged surfaces, buoyancy.	7
3.	**Kinematics of Flow:** Visualisation of flow, types of flow, streamline, pathline, streakline, principle of conservation of mass, velocity, acceleration, velocity potential and stream function, vorticity, circulation.	4
4.	**Fluid D ynamics:** Control volume approach, Euler's equation, Bernoulli's equation and its applications, Reynolds transport theorem, momentum and angular momentum equations and their applications.	7
5.	**Dimensional A nalysis a nd S imilitude:** Dimensional homogeneity, Buckingham's π theorem, dimensionless numbers, similitude.	3
6.	**Boundary L ayer Theory:** Concept of boundary layer, laminar and turbulent boundary layers, boundary layer thickness, von Karman integral equation, laminar sublayer, hydrodynamically smooth and rough boundaries, separation of flow and its control, cavitation.	6
7.	**Laminar an d Turbulent Flow t hrough P ipes:** Laminar flow through pipes, turbulent flow, Reynolds equations, Prandtl's mixing length theory, velocity distribution over a flat plate and in a pipe section, Darcy-Weisbach equation, friction factor, Moody diagram, minor losses, pipe networks, Venturimeter, orifice meter, water hammer, surge tanks	9
8.	**Drag and Lift:** Skin-friction and form drag, drag on sphere, cylinder and flat plate, Karman vortex shedding, generation of lift around a cylinder, lifting vanes.	3
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Som, S.K. and Biswas, G., "Fluid Mechanics and Fluid Mechanics", Tata McGraw Hill.	1998
2.	Garde, R.J. and Mirajgaoker, A.G., "Engineering Fluid Mechanics", Nem Chand & Bros.	1988
3.	Fox, R.W. and McDonald, A.T., "Introduction to Fluid Mechanics", John Wiley & Sons.	2004
4.	Asawa, G.L., "Fluid Flow in Pipes and Channels", CBS Publishers	2008
5.	Schlichting, H. and Gersten, K., "Boundary Layer Theory", Springer.	2004
6.	Streeter, V.L. and Benjamin, W.E., "Fluid Mechanics", McGraw-Hill.	1983

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: **Department of Civil Engineering**

1. Subject Code: **CEN-291**   Course Title: **Engineering Graphics**

2. Contact Hours   **L:2**   **T:2**   **P:0**

3. Examination Duration: **Theory:3**   **Practical:0**

4. Relative weight   **CWS:25**   **PRS:0**   **MTE:25**   **ETE:50**   **PRE:0**

5. Credits:4   6. Semester: **Autumn**   7. Prerequisite: **NIL**

8. Subject Area: **DCC/ESC**

9. Objective of Course: To provide knowledge about the basic concepts of engineering drawing and the methods of generating a Civil Engineering drawing in AUTOCAD.

10. Details of Course

Sl. No.	Contents	Contact Hours
1	**Introduction**: Basics of lettering, dimensioning, types of scales and their uses, types of projections, reference planes and quadrants, projection of points keeping it in different quadrants, auxiliary planes	6
2	**Projection o f L ines an d Planes:** simple lines, parallel lines, distance between lines, angles between skew lines, oblique plane and its traces, conversion of OP into an AVP or IP, H-parallels and V-parallel, lines lying in oblique planes	7
3	**Plane Figures:** Projection of plane figures in different positions	3
4	**Projection of S olids:** Types of solids and their projections in initial positions, projections when base is in IP, AVP or OP, projections when axis inclined to HP or VP, development and sections of solids cut by IP or AVP in their different positions.	6
5	**Generating Drawings in AUTOCAD:** Drawing of building and its components - front view, top view and sectional views of a typical residential building through AUTOCAD, top view at sil level, floor level, and roof level. Drawing of different views of Windows, doors and trusses. Perspective view of a building.	6
	Total	**28**

11. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication/Reprint
1	Chandra, A. M. and Chandra, Satish, "Engineering Graphics", Narosa Publishing House, New Delhi	**2011**
2	Giesecke, Mitchell, "Technical Drawing", Spencer, Hill, Dygdon and Novak, Macmillan Publishing Company.	**2003**
3.	N. Kumara Swamy and A. Kameswara Rao, "Building Planning and Drawing", Charotar Publishing House, New Delhi	**2012**
4.	Gaurav Verma, and Sham Tickoo, "AutoCAD 2012 for Engineers and Designers", Dreamtech Press, New Delhi	**2012**
5.	Bhatt, N. D. and V. M. Panchal, "Engineering Drawing", Charator Publishing House	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Architecture and Planning**

1. Subject Code: **CEN-292**   Course Title: **Theory of Structures**

2. Contact Hours: **L: 3**   **T: 1**   **P: 0**

3. Examination Duration (Hrs)   Theory   **3**   Practical   **0**

4. Relative Weight: **CWS   25   PRS   0   MTE   25   ETE   50   PRE   0**

5. Credits: **4**   6. Semester: **Spring**   7. Subject Area: **DCC**

8. Pre-requisite: **NIL**

9. Objective: To impart knowledge on mechanical properties of common engineering materials, simple types of structural elements and determination of forces and stresses in the elements

10. Details of Course:

S. No.	Contents	Contact Hours
1	Types of Engineering Materials, Introduction to Structural Elements, Types of supports, Stresses and Strains: Elastic Constants and their Mutual Relationships	4
2	Analysis of Trusses: Method of Joints and Method of Sections	6
3	Bending Moment and Shear Force Diagrams for Determinate Beams under Simple Types of Loads, Method of Super Position	6
4	Theory of Simple Bending, Bending and Shear stresses in Symmetrical Sections	6
5	Slopes and Deflections of Beams and Frames, Moment-Area Method, Conjugate Beam Method	8
6	Unit Load Method for Determination of Slopes and Deflections in Beams & Frames and Deflection of Trusses	4
7	Redundant Structures: Static and Kinematic Indeterminacy	2
8	Moment Distribution Method for Analysis of Continuous Beams, Portal Frames and Multistoried Structures	6
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors/Books/Publisher	Year of Publication
1	Kumar, A., "Stability Theory of Structures", Tata McGraw Hill	1985
2	Tung, A. And Christano, P., "Structural Analysis", Prentice Hall International	1987
3	Prakash Rao, D.S., "Structural Analysis", University Press	2007
4	Jain, A.K., "Advanced Structural Analysis", Neam Chand & Bros.	2007
5	Punmia, B.C., Jain, A.K. and Jain, A.K., "Mechanics of Materials", Laxmi Publications (P) Ltd.	2007
6	Jain, A.K., "Strength of Materials and Structural Analysis", Nem Chand & Bros.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Architecture and Planning**

1. Subject Code: **CEN-391**   Course Title: **Design of Reinforced Concrete Elements**

2. Contact Hours: L: **3**   T: **1**   P: **2/2**

3. Examination Duration (Hrs)   Theory: **3**   Practical: **0**

4. Relative Weight: **CWS 20   PRS 20   MTE 20   ETE 40   PRE 0**

5. Credits: **4**   6. Semester: **Autumn**   7. Subject Area: **ESC**

8. Pre-requisite: **NIL**

9. Objective: To impart knowledge in the area of the design of simple reinforced concrete structural elements.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Properties of Concrete and Reinforcing Steels	**3**
2	Design Approaches	**3**
3	Limit State Design of Reinforced Concrete Sections for Bending and Shear; Bond Strength and Development Length; Serviceability; Limit States of Deflection and Cracking	**6**
4	Design of Rectangular, L and T Beams	**9**
5	Design of One-way and Two-way Slabs, Staircases	**9**
6	Design of Columns and Footing for Isolated Columns	**9**
7	Introduction to Framed Buildings and Prestressed Concrete	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors/Books/Publisher	Year of Publication
1	Dayaraatnam, P., "Reinforced Concrete Structures", Oxford & IBH Publishing Co.	2002
2	Jain, A.K., "Reinforced Concrete-Limit State Design", Nem Chand Bros.	2006
3	Sinha, S.N., Reinforced Concrete Design", Tata McGraw Hill.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Chemistry**

1. Subject Code: **CYN-008**   Course Title: **General Chemistry-III**

2. Contact Hours: **L: 3**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.): **Theory : 3**   **Practical : 0**

4. Relative Weightage**: CWS: 15   PRS: 15   MTE: 30   ETE: 40   PRE: 0**

5. Credits: **4**   6. Semester**: Spring**   7. Subject Area**: BSC**

8. Pre-requisite: **Nil**

9. Objective: To impart basic knowledge of chemistry.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Thermodynamics***:* Statistical concept of entropy, description of equilibrium and feasibility of chemical reactions, Clausius-Clapeyron equation, partial molar quantities-chemical potential, ionic activity coefficients.	4
2.	**Kinetics:** Theories of chemical reactions – Draw-backs of collision theory, transition state theory using partition functions and its thermodynamic formulation, consecutive and parallel reactions.	4
3.	**Photochemistry**: Basics of photochemistry, photochemical reactions in aqueous medium and environment, free radicals as reactive intermediates, their methods of preparation and use in synthesis, CFCs and alternatives to CFCs.	4
4.	**Chemistry of Natural Water:** Speciation of acids and bases, pC-pH diagrams and their applications, redox potentials − their uses in chemical speciations, acid-base and redox chemistry of compounds of sulphur, nitrogen and phosphorus including their environmental implications. Heavy metals (Pb, Hg and As) and their speciation causing toxicity.	7
5.	**Corrosion:** Corrosion processes in metals – electrochemical aspects, prevention strategies for corrosion.	2
6.	**Cement Chemistry:** Cement− its constituents and their structures, classification of cement, hydration process and importance of the products of hydration, chemistry of pozzolanic reactions. Analysis of Portland cement with reference to insoluble residue, total silica, sesquioxides, iron, lime and manganese. Role of calcium hydroxide in cement.	7
7.	**Soil Chemistry:** Chemical composition of soils, types of clay minerals, soil colloids, diffused double layers, sorption processes, cation and base exchange phenomenon in soils, isomorphous substitution.	5

8.	**Petroleum Chemistry:** Overview of petroleum processing − fractional distillation, gasoline/petrol − classification, knocking, octane number.	3
9.	**Spectral Techniques**: Introduction of spectroscopic techniques viz., UV-Vis, IR, and Mass spectroscopy for structural prediction of organic compounds.	6
	Total	42

List of Experiments:

i)	Determination of sodium carbonate in baking/washing soda.
ii)	Determination of Zn by EDTA- complexometric titration.
iii)	Determination of nitrogen as ammonia in a sample.
iv)	Determination of viscosity of a polymer in a solution /or in a mixture of liquid.
v)	Determination of surface excess concentration of 1-butanol in aqueous solution.
vi)	Kinetics of a reaction between hydrogen peroxide and iodine in acidic medium.
vii)	Photochemical reduction of ferric oxalate in cyanotype blue printing.
viii)	Spectrophotometric determination of [Fe (III)] by using KSCN.
ix)	Identification of functional groups in an organic compound.
x)	Characterization of an organic/inorganic compound by UV-Vis and IR spectra.
xi)	Sectrophotometric determination of λ_{max} and concentration of $KMnO_4/K_2Cr_2O_7$.
xii)	pH metry/ potentiometry titration: strong acid – strong base.
xiii)	Preparation of potash alum from scrap aluminium.
xiv)	Synthesis of potassium trisoxalatochromate(III).

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Atkins, P.W., "Physical Chemistry", 8th Ed., Oxford University Press.	2006
2.	Turro, N.J., Ramamurthy, V. and Scaiano, J.C., "Modern Molecular Photochemistry of Organic Molecules", University Science Books.	2008
3.	Manahan, S.E., "Environmental Chemistry", 8th Edition, CRC Press.	2005
4.	Masters, G.M. and Ela, W.P., "Introduction to Environmental Engineering and Science", 3rd Ed., Pearson Education.	2008
5.	Taylor, H.F.W., Cement Chemistry, 2nd Ed. (reprinted), Thomas Telford Services Ltd., London.	2004
6.	Morrison, R.T., Boyd, R.N. and Bhattacharjee, S.K., "Organic Chemistry", 7th Ed., Pearson Education in South Asia.	2013
7.	Huheey, J.E., Keiter, E.A., Keiter, R.L. and Medhi, O.K. "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Pearson Education Asia.	2009
8.	Sposito, G., "Chemistry of Soils", 2nd Ed., Oxford University Press.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EEN-112**   Course Title: **Electrical Science**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory: 3**   **Practical: 0**

4. Relative Weight**:   CWS: 15   PRS: 15   MTE: 30   ETE: 40   PRE: 0**

5. Credits**: 4**   6. Semester**: Both**   7. Subject Area**: ESC**

8. Pre-requisite**: NIL**

9. Objective: To introduce the students to the fundamentals of Electrical Engineering concepts of network analysis, principles of electrical machines, basics of electrical measurement and measuring instruments.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Energy Resources an d U tilization:** Conventional and non-conventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization.	5
2.	**Network F undamentals**: Types of Sources and elements, Kirchoff's Laws, Mesh and Node Analysis of D.C. Networks, Network Theorems: Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Theorem, Star-Delta Transformation.	5
3.	**A.C. F undamentals**: Concept of phasor, impedance and admittance; Mesh and Node analysis of AC networks; Network theorems in AC networks; Active and reactive power in AC circuits; Resonance in series AC circuits; Power factor correction.	4
4.	**Three-phase A.C . Circuits**: Analysis of 3-phase balanced start-delta circuits, Power in 3-phase Circuits.	2
5.	**Measurement of E lectrical Qu antities**: Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Energy meters.	5
6.	**Single P hase T ransformer**: Introduction to magnetic circuit concepts, Basic constructional features, operating principle, phasor diagram, equivalent circuit, voltage regulation; Eddy current and Hysteresis losses, efficiency; Open circuit and Short Circuit tests.	5

7.	**D.C. Machines**: Principle of operation, constructional features; Emf and torque equations; Types of excitation; Generator characteristics; Starting and speed control of D.C. motors.	5
8.	**AC Machines**: Three-phase Induction Motor - Operating principle, constructional features, torque-speed characteristics, starting and speed control; Single-phase Induction Motor - Operating principle, constructional features, torque-speed characteristics, starting methods.	5
9.	**Industrial A pplications an d C ontrol: V** arious industrial loads, traction, heating, lighting; Concept of power electronic control of AC and DC motors.	6
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mukhopadhyaya P., Pant A.K., Kumar V. and Chittore D.S., "Elements of Electrical Science", M/s Nem Chand & Brothers.	1997
2.	Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India.	2002
3.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House.	2007
4.	Alexander C.K., Sadiku M.N.O., "Fundamentals of Electric Circuits", McGraw Hill, 5th Edition.	2012
5.	Chapman, Stephen, J., "Electric Machinery Fundamentals", McGraw Hill Book Company.	1985
6.	Hughes Edward, "Electrical & Electronic Technology", Pearson Publishing, 8th edition.	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

1. Subject Code: **MAN-006**   Course Title: **Probability and Statistics**

2. Contact Hours: **L: 3**   **T: 1**   **P : 0**

3. Examination Duration (Hrs.): **Theory: 3**   **Practical: 0**

4. Relative Weightage**: CWS: 25   PRS: 0   MTE: 25   ETE: 50   PRE: 0**

5. Credits**: 4**   6. Semester**: Spring**   7. Subject Area**: BSC**

8. Pre-requisite**: Nil**

9. Objective: To impart techniques of Probability and Statistics.

10. Details of Course:

S.No.	Contents	Contact Hours
1	Concept of probability, random variable and distribution function: discrete and continuous, moments and moment generating functions.	9
2	Special distributions (discrete): Binomial, Poisson, Negative binomial, Geometric. (continuous): Uniform, Exponential, Gamma, Beta, Normal, Lognormal.	9
4	Bivariate random variables: joint, marginal, conditional distribution. Statistical independence, product moment.	3
5	Random sample, law of large numbers, central limit theorem, correlation, regression.	7
6	Estimation: maximum likelihood estimation, unbiasedness and efficiency, interval estimation for normal population with normal, t, χ^2 distribution.	7
7	Testing of Hypothesis: Simple and composite hypothesis, Type I and type II errors. Power of test. Some tests for normal population parameters based on normal, t, χ^2 distribution.	7
	TOTAL	**42**

11. Suggested Books:

S.No.	Title/Authors/Publishers	Year of Publication
1.	Rohatgi, V K. and Saleh , A. K. Md. Ehsanes, "An Introduction to Probability and Statistics", (John Wiley and Sons) , (2nd edition)	2000
2.	Hogg, R. V. and Craig, A., "Probability and Statistical Inference", (Pearson Education), (6th Edition)	2006
3.	Johnson, R. A., Miller, I. and Freund, J. E., "Miller & Freund's probability and statistics for engineers", (Prentice Hall PTR), (8th edition)	2011
4.	Hines, W. W., Montgomery, D. C., Goldsman, D. M. and Borror, C. M.,	2003

	"Probability and Statistics in Engineering", (John Wiley & sons), (4th Edition)	
5.	Papoulis, A. and Pillai, S. U., "Probability, Random Variables and Stochastic Processes", (Tata McGraw-Hill), (4th edition)	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mechanical & Industrial Engineering**

1. Subject Code: **MIN-102**   Course Title: **Basic Manufacturing Processes**

2. Contact Hours: **L: 2**   **T: 0**   **P: 4**

3. Examination Duration (Hrs.):   **Theory: 3**   **Practical: 0**

4. Relative Weightage: **CWS: 15**   **PRS: 15**   **MTE: 30**   **ETE: 40**   **PRE: 0**

5. Credits: **4**   6. Semester: **Spring**   7. Subject Area: **ESC**

8. Pre-requisite: **Nil**

9. Objective: **To introduce fundamentals of manufacturing processes**.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Engineering materials, materials properties & selection of manufacturing process	**2**
2.	**Casting:** Fundamentals of casting process, pattern materials, pattern types, allowances, gating system, molding sand: composition and properties, cores, casting defects and their remedies	**8**
3.	**Joining**: Basic principle of welding, types of weld joints, classification of welding processes, gas welding, manual metal arc welding, welding defects and remedies, soldering and brazing	**6**
4.	**Machining:** Basic principle of machining, lathe, drilling, milling and grinding machines and their operations, cutting tools used	**6**
5.	**Forming:** Fundamentals of metal forming, forging, rolling, extrusion, wire drawing and tube drawing, relevant defects and remedies	**6**
	Total	**28**

11. **LIST OF PRACTICALS**

Sl. No.	Shop	Description
1.	CARPENTRY	Study of Different Carpentry Tools and Pattern Making of T-Joint
2.		Pattern Making of a Wooden Handle
3.	FOUNDRY	Study of Different Foundry Tools and Furnaces
4.		Making a Green Sand Mould of Half Bearing Block
5.		Making Green Sand Mold and Casting of Bearing Block
6.		Demonstration of Injection Molding process
7.	WELDING	Arc Welding of Butt Joint
8.		Gas Welding of Butt Joint

9.		Study of Other Welding/Joining Techniques
10.	MACHINE	Study of Lathe and Job Preparation on it – Lathe Job – 1 (step turning)
11.		Lathe Job – 2 (Threading and Knurling)
12.		Study of Milling Machine and Demonstration of Job Preparation on it
13.		Study of Different Drilling and Boring machines and Preparation of a job involving both operations
14.		Study of Shaping and Planning Machine and preparation of a job
15.		Study of Grinding Machines and Demonstration of Surface Grinding
16.	FITTING	Study of Various Fitting Hand Tools, Marking and Measuring Devices
17.		Preparation of a die (Turn – 1)
18.		Preparation of a die (Turn – 2)
19.	SMITHY	Study of Different Forming Tools and Power Presses
20.		Demonstration of Making of Bolt

12 . Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Kalpakjian, S. and Schmid, S. R, "Manufacturing Engineering and Technology", Pearson Education	2000
2.	DeGarmo, E. P, Black, J. T., Kohser, R. A., "Materials and Processes in Manufacturing",Prentice Hall of India Pvt. Limited	1997
3.	Groover, M. P., "Fundamentals of Modern Manufacturing", Mikell P. Groover, John Wiley and Sons Inc.	2002
4.	Rao, P. N., "Manufacturing Technology (Vol. 1&2)", 3rd Edition, Tata McGraw Hill	2009
5.	Lindberg, R. A., "Processes and Materials of Manufacture", Prentice Hall India Limited	1990

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-203**   Course Title: **Geomatics Engineering II**

2. Contact Hours: **L: 3**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.):   **Theory:3**   **Practical:0**

4. Relative Weight**: CWS:15   PRS: 25   MTE:20   ETE: 40   PRE:0**

5. Credits**:5**   6. Semester**: Autumn**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To impart knowledge on advanced surveying, photogrammetry, remote sensing, and

Geographic Information Systems (GIS).

10. Details of Course:

S. No.	Contents*	Contact Hours
1.	**Introduction:** Introduction of Geomatics Engineering and its applications	2
2.	**Photogrammetry:** aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement.	6
3.	**Stereoscopy**: measurement and parallax and height determination, photogrammetric mapping.	6
4.	**Remote Sensing:** Basic remote sensing, interaction mechanism with atmospheric and earth surface, platforms and sensors	7
5	**Data Products:** Various remote sensing data products, high resolution and Hyperspectral images, visual data interpretation for information extraction.	4
6.	**Digital Image Processing:** Digital image, introduction to digital image processing, preprocessing, enhancement, classification, accuracy assessment.	8
7.	**GIS:** Introduction of geographic information system (GIS), Vector and raster data, database creation, digital elevation model (DEM), Analysis in GIS.	7
8.	**Applications :** Applications in various civil engineering projects.	2
	***Survey Camp of 2 weeks duration with 15 marks**	
Total		**42**

11. Suggested Books:

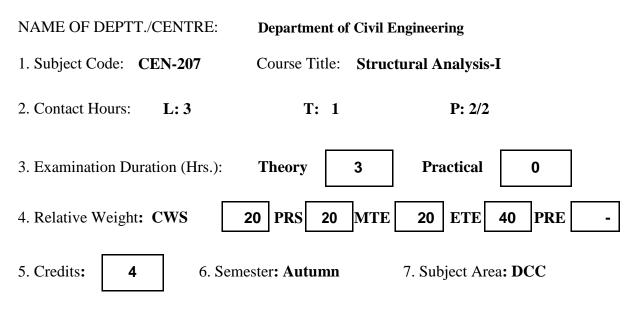| S. No.	Name of Books / Authors/ Publishers	Year of Publication
1.	Agarwal, C.S. and Garg, P.K., "Remote Sensing in Natural Resources Monitoring and Management", Wheeler Publishing House.	2000
2.	Bossler, J.D., "Manual of Geospatial Science and Technology", Taylor and Francis.	2002
3.	Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information System", Oxford University Press.	2000
4.	Chandra, A.M. and Ghosh, S.K., "Remote Sensing and Geographical Information Systems", Alpha Science.	2005
5.	Gopi, S., "Global Positioning System: Principles and Applications", Tata McGraw Hill.	2005
6.	Lillesand, T.L., and Kiefer, R.W., "Remote Sensing and Image Interpretation, 4th Edition, John Wiley & Sons	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-205**   Course Title: **Channel Hydraulics**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory:3**   **Practical:0**

4. Relative Weight**: CWS:20   PRS: 20   MTE:20   ETE:40   PRE:0**

5. Credits**: 4**   6. Semester**: Autumn**   7. Subject Area**: DCC**

8. Pre-requisite**:   CE-142**

9. Objective: To introduce the concepts of channel hydraulics, used in design of inland waterways for irrigation and navigation.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction to Free Surface Flows :** Comparison between pipe and channel flows, classification of channels and basic equations of flow	3
2.	**Concepts of Specific Energy :** Specific energy, critical, subcritical and super critical flows, critical depth computations, transitions and introduction to hydraulic jump	6
3.	**Uniform Flow :** Shear stress and velocity distribution, resistance relationships, normal depth, and its computation design of channels, most efficient cross-section in rigid boundary channels.	7
4.	**Gradually Varied Flow :** Governing equations, characteristics and classification of water surface profiles, control sections, computations of GVF profiles in prismatic and non-prismatic channels.	6
5.	**Hydraulic Jump :** Types of jumps, hydraulic jump in horizontal rectangular channels, forced jump, stilling basins.	5
6.	**Flow Measurement in Open Channels :** Broad and sharp-crested weirs, free overall, flow over spillways, sluice gates.	4
7.	**Fluvial Hydraulics :** Incipient motion, shields diagram, regimes of flow and resistance to flow in mobile bed channels regime channels and design aggradation and degradation of alluvial streams, bridge and abutment scour	7
8.	**Unsteady Flow :** Wave celerity, surges, positive and negative surges, introduction to dam break problem, governing equations, surge tank.	4
	Total	42

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Chow, V.T., "Open Channel Hydraulics", McGraw Hill.	1959
2.	Subramanya, K., "Flow in Open Channels", Tata McGraw-Hill.	1997
3.	Ranga Raju, K.G., "Flow through Open Channels", Tata McGraw-Hill.	2003
4.	Chanson, H., "The Hydraulics of Open Channel Flow: An Introduction", Elsevier Scientific.	2004
5.	Chaudhry, M.H., "Open Channel Flow", Prentice-Hall, New Jersey, USA	1993

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-207**   Course Title: **Structural Analysis-I**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory** | **3** | **Practical** | **0** |

4. Relative Weight**: CWS** | **20** | **PRS** | **20** | **MTE** | **20** | **ETE** | **40** | **PRE** | **-** |

5. Credits**:** | **4** | 6. Semester**: Autumn**   7. Subject Area**: DCC**

8. Pre-requisite**:**   **Nil**

9. Objective: To introduce the fundamentals of the analysis of statically determinate and indeterminate structures.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Equilibrium of statically determinate beams/truss/frames/arches – Finding reactions , drawing free body diagrams, drawing Axial-Force/Shear Force/Bending Moment diagrams	8
2.	Unsymmetric bending, Shear centre.	3
3.	Analysis of cable structures for vertical loads only	2
4.	Strain Energy, Castigliano's Theorems and Theorem of Least Work and Virtual Work	3
5.	Determination of slopes and deflections of determinate beams using (a) Moment-Area Theorems (b) Conjugate beam method (b) Unit Load Method	7
6.	Determination of slopes and deflections of trusses and frames using unit load method	4
7.	Analysis of indeterminate structures by flexibility(/force / consistent deformation) method	10
8.	Analysis of continuous beam by theorem of three moments	1
9.	Analysis of two hinged arches	2
10.	Stiffness coefficients and carry over factors for uniform and non-uniform beams (using Gauss quadrature to compute integrals)	2
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Jain, A.K., "Strength of Materials and Structural Analysis", 2nd Ed., Nem Chand & Bros.	2008
2.	Jain, A.K., "Advanced Structural Analysis", 2nd Ed., Nem Chand & Bros.	2006
3.	Hibbeler, R.C., "Structural Analysis", Pearson Press.	2007
4.	Wang, C.K., "Intermediate Structural Analysis", McGraw Hill.	1987
5.	Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill.	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-202** Course Title: **Waste Water Engineering**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight**:** **CWS: 20** **PRS: 20** **MTE : 20** **ETE: 40** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**:Nil**

9. Objective: To impart basic knowledge of waste water collection, characterization, treatment and safe disposal practices.
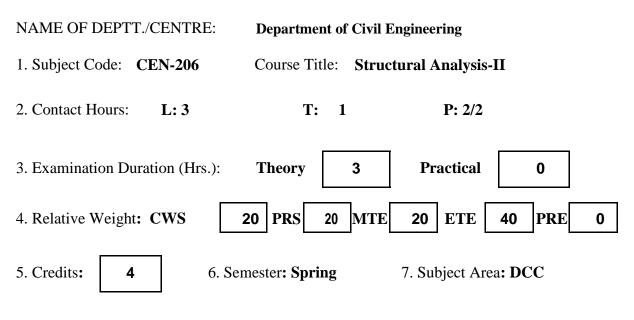
10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction**: An overview of the subject: Domestic and industrial usage of water, generation of contaminated water, its environmental effects, scope of the subject, relationship with civil engineering, conventional objectives and newer challenges in wastewater engineering; Introduction to Wastewater Treatment: Over view of wastewater treatment, different categories of treatment provided – preliminary, primary, secondary, tertiary, sludge handling and disposal, general principles for wastewater treatment, objectives and goals for different trains/ units of wastewater treatment process	**2**
2.	**Wastewater Characterization:** Physical, chemical and biological characterization. Suspended, dissolved and volatile solids, biodegradability of the organics, BOD and its concepts, measurement procedures, CBOD and NBOD, kinetics, COD, ThOD, TOC, Total and Kjeldahl nitrogen, Phosphate, measurement procedures, sources of microbes and pathogens in wastewater, concept of indicator organism, method of determination of indicator organism, quantification methods- Thomas equation, Poisson's distribution.	**8**
3.	**Wastewater Collection:** Generation and estimation of community Sewage, flow variations, storm water flow, estimation of storm-water flow in urban and semi-urban setup - Rational formula, time of concentration, time of entry, time of flow, types of sewers, design considerations, open channel flow- Manning's formula, design of sewer lines, sewer network design principles, alternate systems for sewage collection and conveyance- small bore system, shallow sewer systems, sewer appurtenances- different types of manholes and their constructions, functions, weirs as controlling devices, street inlets, gully traps, siphons, oil and grease traps, outfall structures, design considerations, different types of sections for hydraulically equivalent sections, design of hydraulically equivalent sections.	**6**
4.	**Fundamental concept of reactors:** Mass balance relationships, analysis and descriptions of reactors- batch, completely mixed flow a and plug flow, examples from natural and engineered processes	**3**
5.	**Preliminary and Primary Treatment :** Bar screens, grit chambers, oil and grease removal, primary sedimentation tank – circular and rectangular types, sizing, inlet and outlet arrangements, design of collection launders; Low-cost and On-site Treatment processes: Waste stabilization ponds- aerobic, anaerobic and facultative ponds, Septic Tanks; Aerated lagoons.	**5**
6.	**Secondary Treatment:** Overview of bacterial growth and decay in pure and mixed cultures, Monod's equation, Activated sludge process- analysis, concept of MCRT, SVI, theoretical oxygen requirement, aeration processes and their	**9**

	design, secondary sedimentation tank – zone settling theory and design of secondary settling tank. fixed film growth systems like trickling filters, rotating biological contactor, anaerobic treatment process fundamentals, UASB process, , UASB post treatment.	
7.	**Effect of discharge of contaminated wastewater into surface water:** Mixing of wastewater with surface water, diffusion of dissolved organic matters, degradation, and re-aeration, deduction of Streeter-Phelps model/equation, uses of the model for water quality prediction; Sludge handling, digestion, dewatering and disposal: Sludge thickening, dewatering (Mechanical and sludge drying beds), disinfection, different stages of anaerobic digestion, factors affecting the process, importance of pH and temperature at different stages of the process, methane gas generation, usage of methane gas, design principles for the anaerobic digesters, operation and maintenance, sludge handling, dewatering and methods of disposal of the treatment residuals	5
8.	**Tertiary treatment & Recent Advances**: basic principles of nutrients removal from treated wastewater, nitrogen removal process- nitrification and denitrification, combined nitrification- denitrification process, Bardenpho process, extended aeration and oxidation ditches, Phosphorus removal-A/O, A2/O processes. MBR, MBBR and Microbial fuel cells	4
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Davis, M.L. and Cornwell, D.A., "Introduction to Environmental Engineering", Tata McGraw Hill.	2010
2.	Arcievala, S.J., "Wastewater Treatment for Pollution Control", Tata McGraw Hill.	2000
3.	Hammer, M.J. and Hammer, M.J. Jr. Water and Wastewater Technology, Prentice Hall of India	2008
4.	Tchobanoglous, G., Burton, F.L. and Stensel, H.D., Eddy and Metcalf Wastewater Engineering – Treatment and Reuse, Tata McGraw Hill	2003
5	Manual of Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi.	1993

List of experiments:
1. Determination of DO, BOD, COD.
2. Determination of Nitrite and Nitrate nitrogen.
3. Determination of Ammoniacal and Total Kjeldahl Nitrogen.
4. Determination of phosphorus (total and available).
5. Determination of SVI (including MLSS and MLVSS estimations).
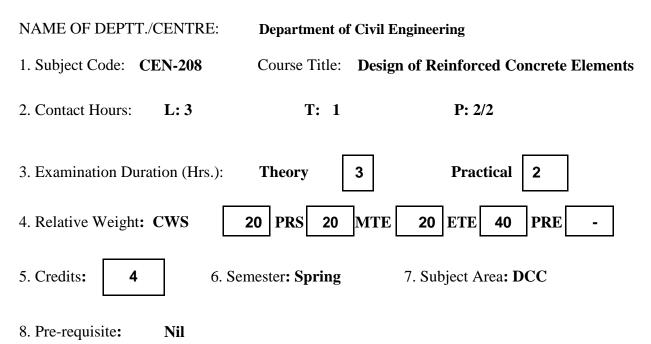6. Settling column test for secondary setting tank design

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-206**   Course Title: **Structural Analysis-II**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.): **Theory** | **3** | **Practical** | **0** |

4. Relative Weight**: CWS** | **20** | **PRS** | **20** | **MTE** | **20** | **ETE** | **40** | **PRE** | **0** |

5. Credits**:** | **4** | 6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**:**   **CE-207**

9. Objective: To introduce the stiffness approach for analysis of statically indeterminate structures.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Influence Lines**:** Analysis for different types of moving loads, use of influence line diagrams, application to determinate structures	7
2.	Muller-Breslau principle with application to determinate and indeterminate structures. Qualitative ILD for continuous beams, frames and arches.	6
3.	Displacement approach: Basic principles	3
4.	Slope deflection method	4
5.	Moment distribution method, frame with/without sway, substitute frame method	5
6.	Matrix displacement method, basic principles, application to planar structures- trusses, beams and frames.	13
7.	Use of symmetry and antisymmetry, reduction of degrees of freedom by equal displacement / rigid-body diaphragm specifications and static condensation. Application of softwares.	4
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Timoshenko, S.P. and Young D. H., "Theory of structures" , McGraw Hill	1965
2.	Ghali, A. and Neville A. M., " Structural Analysis", E & FN Spon	1999
3.	Weaver, W. Jr. and Gere, J.M., "Matrix Analysis of Framed Structures", CBS Publishers.	2000
4.	Gupta, S.P., Pandit, G. S., Gupta, R., " Theory of Structures", Tata McGraw Hill	2011
5.	Wang, C.K., "Intermediate Structural Analysis", McGraw Hill.	1987
6.	Jain, A.K., "Advanced Structural Analysis", Nem Chand & Bros., Roorkee	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-208**   Course Title: **Design of Reinforced Concrete Elements**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.): **Theory** **3**   **Practical** **2**

4. Relative Weight**: CWS** **20** **PRS** **20** **MTE** **20** **ETE** **40** **PRE** **-**

5. Credits**:** **4**   6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**:**   **Nil**

 9. Objective: To introduce the fundamentals of reinforced concrete design and detailing

 10. Details of Course:

S. No.	Contents	Contact Hours
1.	Properties of Concrete **:** Compressive strength, tensile strength, stress-strain behavior, modulus of elasticity, shrinkage, creep, characteristic strength, grades of concrete, design stress-strain curve of concrete, reinforcing steel, types and grades, stress-strain behavior, design stress-strain curve , basic properties of concrete constituent materials and fresh concrete , design of concrete mix.	5
2.	Basic Concepts of Reinforced Concrete Design **:** Working stress and limit state design methods.	3
3.	Design and detailing of R.C. Beams in Flexure : Singly and doubly reinforced rectangular/flanged sections, design for shear, bond and anchorage of reinforcement, limit states of deflection and cracking	8
4.	Design for Torsion: Design of RC beams subjected to torsion and detailing.	5
5.	Design and Analysis of One-way and two-way slabs, design of staircases and detailing.	5
6.	Design and detailing of compression members for axial loads and axial load plus uniaxial moment/ biaxial moments.	6
7.	Foundation types, design and detailing of isolated footings, introduction to combined footings.	4
8.	Stability analysis of retaining walls, design of gravity, cantilever type retaining walls.	6
	Total	42

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Pillai, S.U. and Menon, D., "Reinforced Concrete Design", Tata McGraw- Hill.	2003
2.	Sinha, N.C. and Roy, S.K., "Fundamentals of Reinforced Concrete", S. Chand	2007
3.	Jain, A.K., "Reinforced Concrete Limit State Design", 7th Ed., Nem Chand & Bros., Roorkee	2012
4.	Shah, V.L. and Karve, S.R., "Limit State Theory and Design of Reinforced Concrete", Structures Publication	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-210**   Course Title: **Highway and Traffic Engineering**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory:3**   **Practical :0**

4. Relative Weight**: CWS:20   PRS: 20   MTE:20   ETE:40   PRE:0**

5. Credits**: 4**   6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To introduce the fundamentals and present practices of pavement engineering, highway construction, traffic engineering and geometric design.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Highway Development and Planning:** Historical Development, road patterns, master plans, road development plans, PMGSY, engineering surveys, highway projects.	6
2.	**Highway Materials and Testing:** Embankment, Subgrade soil, sub base and base course materials, bituminous materials, testing of soil, stone aggregates and bitumen.	6
3.	**Highway Geometric Design:** Cross section elements, camber, super elevation, sight distances, horizontal and vertical alignment, summit and valley curves	6
4.	**Traffic Engineering:** Traffic characteristics, road user & vehicular characteristics, traffic studies, road traffic safety, traffic operations, traffic control devices, intelligent transport systems, pollution due to traffic.	8
5.	**Design of Highway Pavements:** Flexible pavements and their design, review of old methods, CBR method, IRC:37-2001, 2012, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC design method (IRC:58-2002).	6
6.	**Highway Construction:** Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements, Hot Mix Plants, Construction of Rigid Pavements	6
7.	**Highway Maintenance:** Various type of failures of flexible and rigid pavements, evaluation Design of overlays by IRC:81-1997.	4
	Total	**42**

11. **List of Experiments**
1. C.B.R. Test
2. Aggregate Crushing Test
3. Aggregate Impact Test
4. Los Angles Abrasion Test
5. Specific Gravity and Water Absorption Test on Aggregates
6. Shape Tests
7. Penetration Test
8. Ductility Test
9. Softening Point Test
10. Flash & Fire Test
11. Specific Gravity Tests on Bitumen
12. Marshall Stability Test

12. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Khanna, S.K. and Justo, C.E.G., "Highway Engineering", Nem Chand & Bros.	1991
2.	Mannering Fred L., Washburn Scott S. and Kilaresk Walter P. Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd,	2011
3.	Kadiyali, L.R., "Traffic Engineering and Transportation Planning", Khanna Publishers.	2002
4.	Roess Roger P., Prassas, Elena S. and McShane, William R., "Traffic Engineering", Prentice Hall.	2011
5.	Papacostas, C.S. and Prevedouros, P.D., "Transportation Engineering and Planning", Prentice Hall.	2002
6.	Jotin Khisty, C. and Kent Lall, B., "Transportation Engineering – An Introduction", Prentice Hall.	2002
7.	Kadiyali, L.R., "Principles of Highway Engineering", Khanna Publishers.	2002
8.	Khanna, S.K., Justo, C.E.G. and A Veeraragavan, "Highway Material and Pavement Testing Manual", Nem Chand & Bros.	2013

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-303**   Course Title: **Soil Mechanics**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.):   **Theory : 3**   **Practical : 0**

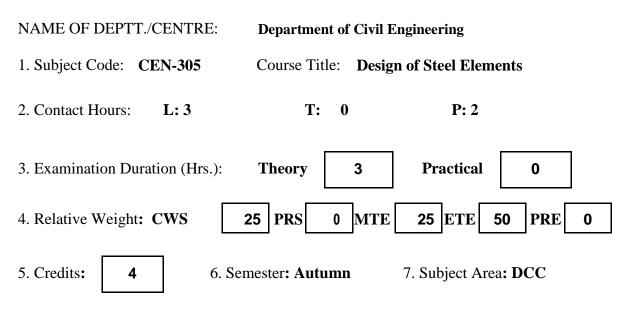4. Relative Weight**: CWS:20   PRS:20   MTE:20   ETE:40   PRE:0**

5. Credits**:4**   6. Semester**: Autumn**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To provide basic concepts of soil mechanics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Physical Properties of Soil :** Soil formation, Soil types, composition, three phase relations, Specific gravity, water content, shape and size, grain size distribution curves, relative density, consistency of soils, Unified soil classification system, IS soil classification system, field identification tests.	7
2.	**Compaction:** Clay minerals, Clay water relations, General principles of compaction, compaction tests, factors affecting compaction, field compaction, compaction techniques.	4
3.	**Capillarity, Permeability and Seepage :** Darcy's law, determination of permeability, equivalent permeability in stratified soils, insitu permeability test, 1-D flow, Laplace's equation, flow nets, seepage, uplift pressure, confined and unconfined flows, piping, filter criteria.	10
4.	**Compressibility and Consolidation :** Fundamentals, 1-D consolidation, normally and over-consolidated clays, void ratio – pressure relationships, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement, secondary consolidation, 3-D consolidation, vertical sand drains.	10
5.	**Shear Strength of Soil :** Principle of effective stress, Mohr-Coulomb failure criterion, direct shear test, unconfined compression test, Triaxial shear test : consolidated drained, consolidated undrained, unconsolidated undrained, vane shear test, shear strength of clays and sands, critical void ratio, stress path, pore-pressure coefficient.	11
	Total	42

11. List of Experiments :

Determination of Moisture Content, Grain Size Distribution Analysis, Hydrometer Analysis, Atterberg Limits (LL, PL, SL), Compaction Test, Permeability Test, Unit Weight Determination, Specific Gravity, Unconfined Compression Test, Direct Shear Test, Vane Shear Test, Triaxial Test (demonstration), Consolidation Test (demonstration) and Visual Classification Tests (demonstration).

12. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Holtz, R.D. and Kovacs, W.D., "An Introduction to Geotechnical Engineering", Prentice Hall.	1981
2.	Lambe, T.W. and Whitman, R.V., "Soil Mechanics", John Wiley and Sons.	2000
3.	Das, B.M., "Principles of Geotechnical Engineering", Thomson Asia.	2002
4.	Couduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India.	2002
5.	Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers.	2007
6.	Murthy, V.N.S., "Text Book of Soil Mechanics and Foundation Engineering", CBS Publishers.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-305**   Course Title: **Design of Steel Elements**

2. Contact Hours: **L: 3**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.):   **Theory** | **3** | **Practical** | **0** |

4. Relative Weight**: CWS** | **25** | **PRS** | **0** | **MTE** | **25** | **ETE** | **50** | **PRE** | **0** |

5. Credits**:** | **4** | 6. Semester**: Autumn**   7. Subject Area**: DCC**

8. Pre-requisite**:   Nil**

9. Objective: To impart knowledge of design of basic structural steel elements as per relevant codal practices.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction, properties of structural steel and structural steel sections	2
2.	Basic Concepts of Steel Design : Working Stress and Limit State Method	2
3.	Introduction to Connections : Bolted (Ordinary and HSFG) and Welded connections	4
4.	Tension members	2
5.	Compression members, Builtup Columns, Beam Columns and Column Splices	4
6.	Design of Beams : Laterally Supported , Unsupported and Builtup Beams	4
7.	Plate-girders including stiffeners, Splices and Curtailment of flange and web plates	5
8.	Column bases, Slab base, Gusseted base and Grillage footings	4
9.	Beam to column connection, Introduction to semi-rigid connections	5
10.	Roof truss – Design of various components for different loadings (Dead, Live and Wind loads), Purlins, Gantry Girders	6
11.	Plastic Analysis	4
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Arya, A.S. and Ajmani, J.L., "Design of Steel Structures", Nem Chand & Bros.	2000
2.	Subramanian, N., "Design of Steel Structures", Oxford University Press	2008
3.	Englekirk, R., "Steel Structures –Controlling behavior through design", John Wiley & Sons, New York	1994
4.	Trahair, N.S., Bradford, M.A. et al., "The Behavior and Design of Steel Structures to EC3", Taylor and Francis, London	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: **Department of Civil Engineering**

1. Subject Code: **CEN-307**   Course Title: **Railway Engineering and Airport Planning**

2. Contact Hours: **L:3**   **T:1**   **P: 0**

3. Examination Duration   **Theory:3**   **Practical:0**

4. Relative weight: **CWS:25   PRS:0   MTE:25   ETE: 50   PRE:0**

5. Credits**:4**   6. Semester: **Autumn**   7. Subject Area: **DCC**

8. Prerequisite: **Nil**

9. Objective of Course: To make the students aware of the fundamentals of Railway Engineering and Airport Planning and latest developments on Indian Railways.

10. Details of Course

Sl. No.	Contents	Contact hours
1	**Introduction**: Modes of transportation, universal scenario and Indian railways, railway track development, component parts, gauge, wheel and axle arrangement	**05**
2.	**Resistances and Stresses:** Various resistances and their evaluation, hauling capacity, tractive effort, locomotives and their classification, stresses in the track and its components.	**05**
3.	**Component parts and design of railway track:** Rails and their requirements, creep and wear in rails, rail joints, long welding rails and short welded rails, types of sleepers and their merits and demerits, requirements of ballast, design of ballast section, track fastenings, check rails and guard rails, railway cross-section, various types of gradients, design of horizontal curves, transition curves and vertical curves, existing provisions on IR.	**10**
4.	**Points and Crossings and Signals:** Working and design of a turnout, types of track junctions, design of crossover and diamond crossing, types of signals and their functions, interlocking, advanced methods of train control. High speed rails.	**8**
5.	**Air Transport**: Scenario in India, national and international agencies, aircraft characteristics, site selection, airport obstructions, imaginary surfaces.	**6**
6.	**Design of Airside features:** Runway orientation, geometric design of runway, taxiway, exit taxiway, apron, holding apron, runway configuration, visual aids.	**8**
	Total	**42**

11.Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Chandra, Satish and Agarwal, M. M., "Railway Engineering", Oxford University Press, New Delhi	2nd edition 2013
2	Arora, S. P. and Saxena, S. C, "A Textbook on Railway Engineering", Dhanpat Rai Publications (P) Ltd., New Delhi	7th edition, 2006
3.	Mundrey, J. S., "Railway Track Engineering", Tata McGraw-Hill Publishing Company, New Delhi.	4th edition 2009
3.	Khanna, S. K., Arora, S. P. and Jain, S. S., "Airport Planning and Design", Nem Chand and Bros, Roorkee.	6th edition 1999
5.	Kumar, V., Chandra, S., "Air Transportation Planning and Design", Galgotia Publications Pvt. Ltd., New Delhi.	1st edition 1999
4.	Saxena, S. C., "Airport Engineering: Planning and Design", CBS Publishers & Distributors Pvt. Ltd., New Delhi.	1st edition 2008
5.	Horonjeff, R., McKelvey, F. X., Sproule, W. J., Young, S. B., "Planning and Design of Airports", McGraw-Hill Professional Publishing, New York.	5th edition 2010
6.	Ashford, N. J., Mumayiz, S., Wright, P. H., "Airport Engineering: Planning, Design and Development of 21st Century Airports", John Wiley & Sons, New Jersey.	4th edition 2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Civil Engineering**

1. Subject Code: **CEN-306**   Course Title: **Foundation Engineering**

2. Contact Hours: **L: 3**   **T: 1**   **P: 2/2**

3. Examination Duration (Hrs.): **Theory :3**   **Practical: 0**

4. Relative Weight**: CWS:20**   **PRS:20**   **MTE:20**   **ETE:40**   **PRE:0**

5. Credits**: 4**   6. Semester**: Spring**   7. Subject Area**: DCC**

8. Pre-requisite**: CE-303**

9. Objective: To provide knowledge base on the current practices in foundation engineering to carry out the job of selection, design and construction of foundations.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Role of civil engineer in the selection, design and construction of foundation of civil engineering structures, brief review of soil mechanics principles used in foundation engineering. Soil Exploration : Methods of soil exploration; boring, sampling, penetration tests, correlations between penetration resistance and soil design parameters.	7
2.	**Earth Pressure and Retaining Walls:** Earth pressure at rest, active and passive earth pressure, Rankine and Coulomb's earth pressure theories, earth pressure due to surcharge, retaining walls, stability analysis of retaining walls, proportioning and design of retaining walls.	7
3.	**Foundations:** Types of foundations, mechanism of load transfer in shallow and deep foundations, shallow foundations, Terzaghi's bearing capacity theory, computation of bearing capacity in soils, effect of various factors, use of field test data in design of shallow foundations, stresses below the foundations, settlement of footings and rafts, proportioning of footings and rafts, sheeting and bracing of foundation excavation.	10
4.	**Deep Foundations :** Pile Foundations : Types and methods of construction, estimation of pile capacity, capacity and settlement of group of piles, proportioning of piles. Well foundations: Methods of construction, tilt and shift, remedial measures, bearing capacity, settlement and lateral stability of well foundation.	9
5.	**Slopes:** Mode of failure – mechanism, stability analysis of infinite slopes, methods of slices, Bishop's simplified method.	5
6.	**Machine Foundations:** Types of machine foundations, mathematical models, response of foundation – soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design.	4
	Total	42

11. List of Experiments :

Methods of Boring, Standard Penetration Test, Dynamic Cone Penetration Test, Plate Load Test, Triaxial Tests (UU, CU, CD), Consolidation Tests and Static Cone Penetration Test (demonstration).

12. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Peck, R.B., Hanson, W.E. and Thornburn, T.H., "Foundation Engineering", John Wiley.	1974
2.	Couduto, Donald P., "Geotechnical Engineering – Principles and Practices", Prentice-Hall.	1999
3.	Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age.	2000
4.	Som, N.N. and Das, S.C., "Theory and Practice of Foundation Design", Prentice-Hall.	2003
5.	Das, B.M., "Principles of Foundation Engineering", PWS.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE:　　　**Civil Engineering Department**

1. Subject Code:　**CEN-308**　　　Course Title:　**Design of Structural Systems**

2. Contact Hours:　　**L: 4**　　　　　**T:　1**　　　　**P: 2/2**

3. Examination Duration (Hrs.):　　**Theory**　| **3** |　**Practical**　| **0** |

4. Relative Weight**: CWS** | **15** | **PRS** | **15** | **MTE** | **20** | **ETE** | **50** | **PRE** | **0** |

5. Credits**:** | **5** |　　6. Semester**: Spring**　　7. Subject Area**: DCC**

8. Pre-requisite**:**　　**CE-205**　&　**CE-306**

9. Objective:　　　　To introduce the concepts of the analysis and design of concrete and steel structural systems

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Design loads on buildings, wind and earthquake loads.	**2**
2.	Design of continuous R.C. beams, moment redistribution	**3**
3.	Analysis and design of RC framed buildings; Framing systems, member proportioning, loadings: vertical and lateral loads, approximate methods for the lateral load analysis of building frames and component design including provisions of ductile detailing.	**6**
4.	Design of solid slab and T-beams bridge, standard specifications and general design considerations	**6**
5.	Design of overhead water tanks, general design consideration for circular & Intze tanks.	**6**
6.	Pre-stressed concrete; Materials, prestressing systems, stress analysis & losses of prestress, design of simple beams.	**6**
7.	Analysis and design of cold formed steel structural systems: flexural and compression member	**8**
8.	Analysis and design of steel concrete composite structures	**6**
9.	Analysis and design of steel towers	**5**
10.	Analysis and design of steel truss bridge	**8**
	Total	**56**

11. Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1.	Sinha, N.C. and Roy, S.K." Fundamentals of Reinforced Concrete" S. Chand	2007
2.	Arya, A.S. and Ajmani, J.L., "Design of Steel Structures", Nem Chand & Bros.	2000
3.	Rajagopalan, N., " Prestressed Concrete", Narosa Publication	2005
4.	Krishna, J. and Jain O.P., "Plain and Reinforced Concrete", Vol. 2, Nem Chand and Bros.	1983
5.	Englekirk, R., "Steel Structures –Controlling behavior through design", John Wiley & Sons, New York	1994
6.	Trahair, N.S., Bradford, M.A. et al., "The behavior and design of Steel Structures to EC3, Taylor and Francis, London	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **DEPARTMENT OF CIVIL ENGINEERING**

1. Subject code: **CEN-105**   Course Title: **Introduction to Environmental Studies**

2. Contact Hours: **L: 3   T: 0   P: 0**

3. Examination Duration (Hrs): **Theory:** 3   **Practical:** 0

4. Relative Weightage: **CWS:** 15   **PRS:** 0   **MTE:** 35   **ETE:** 50   **PRE:** 00

5. Credits: **3**   6. Semester: **Autumn**   7. Subject Area: **GSC**

6. Pre-requisite: **Nil**

7. Objective: To introduce fundamentals of environmental pollution and its control.

8. Details of Course:

S. No.	Contents	Contact Hours
1.	Overview: Environment and Natural Processes; Development (Resource Utilization & Waste Generation); Environmental issues; Concept of Sustainable Development; Issues affecting future development (population, urbanization, health, water scarcity, energy, climate change, toxic chemicals, finite resources etc.); Environmental units	6
2.	Air –Water interaction: (Liquid phase-gas phase equilibrium) Henry's Law Constant with units, Dimensionless Henry's Law Constant	3
3.	Water –Soil Interaction: Carbonate System (Alkalinity and buffering capacity); Major ions in water; Natural Organic Matter (NOMs); Water quality parameters; Physical processes (Mass Balance): Spatio-temporal variation in quality of river water, lake water, ground water; Water quality standards	9
4.	Wetlands, water treatment and wastewater treatment .	6
5.	Air resources: Atmosphere; Air pollutants; Emissions and control of air pollutants; Atmospheric meteorology and dispersion; Transport of air (global, regional, local); Air/ atmospheric stability; Plume shape; Gaussian modeling; Air quality standards	9
6.	Land pollution and solid waste management	3
7.	Ecosystem: Structure and function; Energy flow in ecosystem; Material flow in ecosystem; Biodiversity and ecosystem health; Bio-amplification and bio-magnification	3
8.	Hazardous Waste: Definition; Classification; Storage and management; Site remediation; Environmental Risk: assessment, and management	3
Total		**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e	2008
2.	Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e	2007
3.	Peavy H. S., Rowe D.R. and Tchobanoglous G., "Environmental Engineering", McGraw Hill, New York	1986
4.	Mines R. O. and Lackey L. W. ""Introduction to Environmental Engineering", Prentice Hall, New Yark	2009
5.	Miheicic J. R. and Zimmerman J. B. " Environmental Engineering: Fundamentals, Sustainability, Design" John Wiley and Sons, Inc.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-001A**   Course Title: **Communication Skills (Basic)**

2. Contact Hours: **L: 1**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.):   **Theory** | **2** | **Practical** | **0** |

4. Relative Weight**:**   **CWS** | **25** | **PRS** | **00** | **MTE** | **25** | **ETE** | **50** | **PRE** | **0** |

5. Credits**:** | **2** | 6. Semester**: Autumn/Spring**   7. Subject Area**: HSS**

8. Pre-requisite**: NIL**

9. Objective:
The course intends to build the required communication skills of the students having limited communicative abilities, so that they may communicate effectively in real-life situations

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Understanding the Basics of Communication Skills: Listening, Speaking, Reading & Writing, Scope and Importance	**01**
2.	Grammar & Composition: Time and Tense, Agreement, Active-Passive, Narration, Use of Determiners, Prepositions & Phrasal Verbs	**05**
3.	Vocabulary Building & Writing: Word-formation, Synonyms, Antonyms, Homonyms, One-word Substitutes, Idioms and Phrases, Collocations, Abbreviations of Scientific and Technical Words	**02**
4.	Introduction to Sounds (Vowels & Consonants) Organs of Speech, Place and Manner of Articulation, Stress & Intonation, Listening Comprehension (Practical Sessions in Language Laboratory)	**02**

5.	Speaking, Countering Stage-fright and Related Barriers to Communication.	02
6.	Reading and Comprehension: Two lessons to be identified by the department.	02
	Total	**14**

List of Practicals:

1. Ice-breaking Exercises
2. Assignments on Time and Tense, Agreement, Active-Passive
3. Laboratory Session on Narration, Use of Determiners, Prepositions & Phrasal Verbs, Revisionary Exercises & Quiz
4. Laboratory Session on Synonyms, Antonyms, Homonyms
5. Assignments and Practice Sheets on One-word Substitutes, Idioms and Phrases, Collocations, Abbreviations of Scientific and Technical Words
6. Laboratory Session on Practice of sounds, Intonation and Stress, Listening Comprehension
7. Individual presentation, debates, Extempore & Turncoats
8. Exercises in Composition and Comprehension

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Murphy, Raymond. *Intermediate English Grammar*, New Delhi, Cambridge University Press.	**2009**
2.	Quirk, Randolph & Sidney Greenbaum. *A University Grammar of English*, New Delhi, Pearson.	**2009**
3.	McCarthy, Michael & Felicity O' Dell. *English Vocabulary in Use*, New Delhi, Cambridge University Press	**2010**
4.	Jones, Daniel. *The Pronunciation of English*, New Delhi, Universal Book Stall.	**2010**
5.	Birchfield, Susan M. *Fowler's Modern English Usage*, New Delhi, OUP.	**2004**
6.	Llyod, Susan M. *Roget's Thesaurus of English Words and Phrases*. New Delhi: Penguin.	**2010**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-001B**   Course Title: **Communication Skills (Advanced)**

2. Contact Hours: **L: 1**   **T: 0**   **P: 2**

3. Examination Duration (Hrs.): **Theory** **2**   **Practical** **0**

4. Relative Weight: **CWS** **25** **PRS** **00** **MTE** **25** **ETE** **50** **PRE** **0**

5. Credits: **2**   6. Semester: **Autumn/Spring**   7. Subject Area: **HSS**

8. Pre-requisite: **NIL**

9. Objective: The course intends to train the learners in using both verbal and non-verbal communication effectively.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Advanced Communication Skills: Scope, Relevance, & Importance	**01**
2.	Soft Skills: Interpersonal Communication; Verbal & Non-verbal, Persuasion, Negotiation, Neuro-Linguistic Programming	**03**
3.	Communication and Media (Social and Popular), The Social and Political Context of Communication, Recent Developments and Current Debates in Media	**04**
4.	Cross-cultural and Global Issues in Communication: Race, Ethnicity, Gender & Diaspora	**03**
5.	Rhetoric and Public Communication, Audience Awareness, Emotionality	**03**
	Total	**14**

List of Experiments:

1. Discussion on the Process of Communication in Personal and Professional Life
2. Group Discussion, Case Studies and Role-Play
3. Assignments on E-mail Etiquette, Social Networking, Blog Writing, Discussions on Current Issues
4. Non-Verbal Communication in Cross-Cultural Situations, Case Studies, Group Discussions and Readings on Topics Related to Race, Ethnicity, Gender and Diaspora
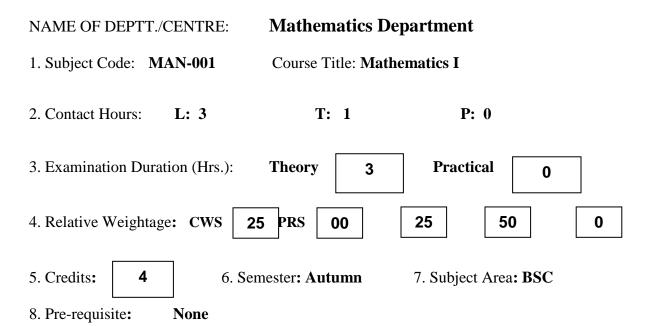5. Individual Presentations (Audience Awareness, Delivery and Content of Presentation)

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Rentz, Kathryn, Marie E. Flatley & Paula Lentz. *Lesikar's Business Communication CONNECTING IH A DIGITAL WORLD*, McGraw-Hill, Irwin	2012
2.	Bovee, Courtland L & John V. Thill. *Business Communication Today*. New Delhi, Pearson Education	2010
3.	McMurrey, David A. & Joanne Buckley. *Handbook for Technical Writing*, New Delhi, Cengage Learning.	2009
4.	Jones, Daniel. *The Pronunciation of English*, New Delhi, Universal Book Stall.	2010
5.	Allan & Barbara Pease. *The Definitive Book of Body Language,* New York, Bantam	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HSN-002**   Course Title: **Ethics and Self-awareness**

2. Contact Hours: **L: 01**   **T: 0 1**   **P: 0**

3. Examination Duration (Hrs.):   **Theory   2**   **Practical   0**

4. Relative Weight**:   CWS:25   PRS:0   MTE:25   ETE:50   PRE:0**

5. Credit **02**   6. Semester**: Autumn**   7. Subject Area**: HSSC**

8. Pre-requisite**: NIL**

9. Objective: To introduce the concepts pertaining to ethical and moral reasoning and action and to develop self - awareness.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction**: Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.	1
2	**Psycho-social theories of moral development**: View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday context.	3
3	**Ethical Concerns**: Work Ethics and Work Values, Business Ethics, Human values in organizations.	3
4	**Self-Awareness**: Self Concept: Johari Window, Self and Culture, Self Knowledge, Self-Esteem; Perceived Self-control, Self-serving bias, Self-presentation, Self-growth: Transactional Analysis and Life Scripts.	4
5.	**Self Development**: Character strengths and virtues, Emotional intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).	3
	Total	**14**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication
1.	Hall, Calvin S., Lindzey, Dardner., & Cambell, John B.,"Theories of Personality",Hamilton Printing Company.	1998
2.	Car Alan, "Positive Psychology: The Science of Happiness and Human Strengths", Brunner-Routledge.	2004
3.	Leary M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press.	2004
4.	Louis P. P., "The Moral Life: An Introductory Reader in Ethics and Literature", Oxford University Press.	2007
5.	Corey, G., Schneider Corey, M., & Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole.	2011
6.	Snyder, C.R., Lopez, Shane, J., & Pedrotti, J.T., "Positive Psychology" Sage, 2nd edition.	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Mathematics Department**

1. Subject Code: **MAN-001**   Course Title: **Mathematics I**

2. Contact Hours: **L: 3**   **T: 1**   **P: 0**

3. Examination Duration (Hrs.):   **Theory** | **3** | **Practical** | **0** |

4. Relative Weightage**: CWS** | **25** | **PRS** | **00** | | **25** | | **50** | | **0** |

5. Credits**:** | **4** | 6. Semester**: Autumn**   7. Subject Area**: BSC**

8. Pre-requisite**:** **None**

9. Objective: **To provide essential knowledge of basic tools of Differential Calculus, Integral Calculus , Vector Calculus and Matrix Algebra for degree students.**

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Matrix Algebra:** Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties. Eigen-values and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	8
2.	**Differential Calculus:** Limit, Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Error approximations. Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers	12
3.	**Integral Calculus:** Review of curve tracing and quadric surfaces, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions. Dirichlet's integral. Applications of Multiple integrals such as surface area, volumes, centre of gravity and moment of inertia..	12
4.	**Vector Calculus:** Differentiation of vectors, gradient, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl. Line and surface integrals. Green's, Gauss and Stroke's theorem and their applications.	10
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K.	2011
2.	R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House.	2005
3.	M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, 11th Edition, Pearson Education.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE:　　　　**Department of Physics**

1. Subject Code: **PHN-001**　　　　Course Title:　**Mechanics**

2. Contact Hours:　**L: 3**　　　　**T: 0**　　　　**P: 2**

3. Examination Duration (Hrs.):　**Theory: 3**　　　　**Practical: 0**

4. Relative Weightage**:　CWS: 15　　PRS: 25　　MTE: 20　　ETE: 40　　PRE: 0**

5. Credits**: 4**　　　　6. Semester**: Autumn**　　　　7. Subject Area**: BSC**

6. Pre-requisite**:　None**

7. Objective: **To familiarize students with the basic principles of mechanics**

8. Details of Course:

S.No.	Contents	Contact Hours
1	**STATICS OF PARTICLES.** Vectorial representation of forces and moments- Vector Operation-Concepts of Particles and Rigid bodies – Composition of concurrent forces in plane free body Diagram – Equilibrium of Rigid bodies in Two and three dimensions-Moment of a force about a point and about an axis-Couple moment-Reduction of a force system to a force and a couple	8
2	**PROPERTIES OF SURFACES, MOMENTS AND PRODUCTS OF INERTIA** Definition Moment of Inertia for areas-Parallel axis theorem –Perpendicular axis theorem-Moment of inertia for composite area-product of inertia form an area-mass moment of inertia	6
4	**FRICTION** Laws of coulomb friction- Coefficient of Friction-Dry Friction-sliding Friction-Ladder friction-Belt friction – Rolling Resistance.	4
5	**KINEMATICS OF PARTICLES** Principle of virtual work for a particle and rigid body-condition for equilibrium for a conservative system, stability-particle dynamics in rectangular coordinate, cylindrical coordinate and in terms of path variables-General motion of system of particles-	8
6	**WORK ENERGY METHODS, IMPULSE AND MOMENTUM** Work Energy Method-Conservation of Energy-Impulse and Momentum Relation-Impulsive Force-Impact force-Conservation of momentum – Moment of Momentum Equation.	8
7	**RIGID BODY MOTION;** Translation and rotation of rigid bodies- Derivative of a vector fixed in moving reference-General relationship between time derivative of a vector for different references-Moment of momentum equation-kinetic energy of rigid body-work and energy relations-Euler's equation of motion-Three dimensional motion about a fixed point	8
	TOTAL	42

List of experiments:

1. Study of magnetic field of a pair of coils in Helmholtz arrangement
2. Determination of e/m
3. Determination of first excitation potential of a gas by Frank-Hertz experiment
4. Determination of Stefan's constant
5. Determination of Planck's constant by radiation
6. To study and verify Malus' law
7. Study of Polarization of light using quarter wave plate
8. Determination of Brewster's angle at glass-air interface
9. Determination of with of a slit by single-slit diffraction pattern
10. Four probe method of finding resistivity of semiconductor
11. Quinck's Method for determining mass susceptibility
12. Wavelength of Na light by Newton's ring method

11. Suggested Books:

S.No.	Title/Authors/Publishers	Year of Publication
1.	Shames I.H. and Rao G.K., "Engineering Mechanics-Statics and Dynamics" ,4 Edition, Pearson Education	2006
2.	Beer F.P and Johnson E.R., "Vector Mechanics for Engineers- Statics and Dynamics",9 Edition, Tata McGraw-Hill Publishing Company	2010
3.	Pytel A. and Kiusalaas J., " Engineering Mechanics: Statics" 3rd Edition, Cengage Learing	2010
4.	Pytel A. and Kiusalaas J., " Engineering Mechanics: Dynamics"3rd Edition Cengage Learing	2010
5.	Hibberler R.C and Gupta A., Engineering Mechanics,", 12th Edition, Pearson Education	2012
6.	Meriam J.L. and Kraige L.G., "Engineering Mechanics: Statics", 6th Edition, John Willey and Son,s	2012
7.	Meriam J.L., and Kraige L.G., "Engineering Mechanics: Dynamics", 6th Edition , John Willey and Son's	2012