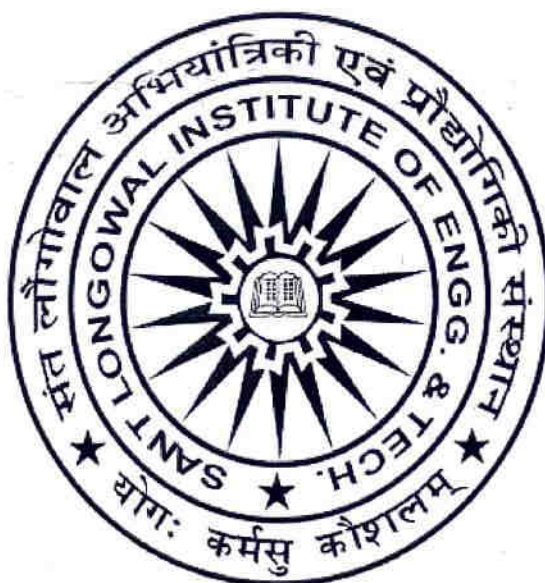


**Scheme & Syllabus
For
Bachelor of Engineering
In
Civil Engineering
(July 2025 admission onwards)**



**Sant Longowal Institute of Engineering and Technology
(Deemed to be University, under Ministry of Education, Govt. of India)
Longowal -148106, Distt. Sangrur (Pb.), India**

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Vision of the department

The department shall strive to act as a podium for the development and transfer of technical competence in academics, impart appropriate skills, entrepreneurship and research in the field of Civil Engineering to meet the changing need of society.

Mission of the department

1. To provide modular programmes from skill development to the research level.
2. To impart technical education and training in innovative state-of-the-art technology in the field of civil engineering.
3. To disseminate knowledge and information by organizing seminars/ workshops/short term courses in a planned manner.
4. To provide extension services to rural society, industry professionals, institutions of research and higher learning in the field of civil engineering.
5. To interact with the industry, educational and research organizations, and alumni in the fields of curriculum development, training and research for sustainable social development and changing needs of society.

Page 18 of 20 ii
Rajinder Singh

Program Education Objectives (PEOs)

The Program Educational Objectives of the Civil Engineering undergraduate program are for graduates to achieve the following, within few years of graduation. The graduates of Civil Engineering Program will

- PEO 1:** Contribute to the Nation's growth, enabling the time-bound creation of world-class infrastructure in the country and delivering sustainable solutions for rural and urban development.
- PEO 2:** Pursue professional development to enhance their undergraduate degree and advance their careers.
- PEO 3:** Exhibit commitment; engage in lifelong learning and continuous improvement for enhancing their professional and personal capabilities.
- PEO 4:** To participate in life-long learning in the relevant domain for addressing global societal needs.

Programme Outcomes (POs)

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and manufacturing/welding specialisation for the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyse complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex civil engineering problems or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

Conduct investigations of complex problems: Conduct investigations of complex construction problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Modern tool usage: To apply appropriate techniques, resources, engineering, and IT tools for modelling of different civil engineering problems with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the civil engineering practice.

Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex civil engineering activities with the engineering community and with the society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of civil engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Participate and succeed in competitive examination for higher studies.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Graduates having an ability to identify, analyze and solve engineering problems relating to civil engineering together with allied engineering streams. Graduates will be able to build the nation, by imparting technological inputs and managerial skills to become Technocrats and Entrepreneurs. Graduates will be able to develop new concepts on various emerging fields and pursue advanced research.

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TEACHING SCHEME

Semester-I							
S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	BSMA-401	Engineering Mathematics I	3	1	0	4	4
2	BSCH-401	Applied Chemistry	3	1	0	4	4
3	ESME-401	Elements of Mechanical Engineering	2	1	0	3	3
4	ESME-402	Workshop Technology and Practice	1	0	0	1	1
5	HSMC-401	English Communication and Soft Skills	1	0	0	1	1
6	BSCH-402	Applied Chemistry Lab	0	0	2	2	1
7	ESME-403	Elements of Mechanical Engineering Lab	0	0	2	2	1
8	ESME-404	Engineering Drawing	0	0	4	4	2
9	ESME-405	Workshop Technology and Practice Lab	0	0	4	4	2
10	HSMC-402	English Communication and Soft Skills Lab	0	0	2	2	1
11	MCCH-401	Environmental Studies	3	0	0	3	0
Total			13	3	14	30	20
Semester-II- A							
S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	BSMA-402	Engineering Mathematics II	3	1	0	4	4
2	BSPH-401	Applied Physics	3	1	0	4	4
3	ESEE-401	Elements of Electrical Engineering	2	1	0	3	3
4	ESCS-401	Elements of Computer Engineering	2	0	0	2	2
5	ESEC-401	Elements of Electronics Engineering	2	0	0	2	2
6	BSPH-402	Applied Physics Lab	0	0	2	2	1
7	ESEE-402	Elements of Electrical Engineering Lab	0	0	2	2	1
8	ESCS-402	Elements of Computer Engineering Lab	0	0	4	4	2
9	ESEC-402	Elements of Electronics Engineering Lab	0	0	2	2	1
Total			12	3	10	25	20
Semester-II-B							
1	TPIN-421	Practical Training During Summer Vacations (In- house) 02 weeks	0	0	40	40	1 (S/US)
2	TPIN-422	Technical competency	0	0	40	40	1(S/US)
Semester-III							
S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PCCV-511	Surveying-I	3	0	0	3	3
2	PCCV-512	Fluid Mechanics	3	1	0	4	4
3	PCCV-513	Building materials and Construction	3	0	0	3	3
4	ESME-501	Engineering Mechanics	3	1	0	4	4
5	HSMC-501	Principles of Management	3	0	0	3	3
6	PCCV-514	Surveying-I Lab	0	0	2	2	1
7	PCCV-515	Fluid Mechanics Lab	0	0	2	2	1
8	PCCV-516	Building Materials and Construction Lab	0	0	2	2	1
9	MCMH-501	Indian Constitution	3	0	0	3	0

		Total	21	2	8	26	20
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Semester-IV-A

S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	BSMA-501	Numerical and Statistical Methods	3	0	0	3	3
2	PCCV-521	Solid Mechanics	3	0	0	3	3
3	PCCV-522	Transportation Engineering I	3	0	0	3	3
4	PCCV-523	Design of Concrete Structures	3	0	0	3	3
5	PCCV-524	Hydrology and Ground Water	3	0	0	3	3
6	BSBL-501	Biology for Engineers	2	0	0	2	2
7	MCUG-501	Universal Human Values-II: Understanding Harmony	3	0	0	3	0
8	BSMA-502	Numerical and Statistical Methods Lab	0	0	2	2	1
9	PCCV-525	Solid Mechanics Lab	0	0	2	2	1
10	PCCV-526	Transportation Engineering I Lab	0	0	2	2	1
		Total	20	0	6	26	20

Semester-IV-B

1	TPID-521	Surveying camp 02 weeks	0	0	80	80	2 (S/US)
2	EAA-521+ A/B/C)	Extra Academic activity Group A/B/C	-	-	-	-	1 (S/US)

Semester-V A

S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PCCV-611	Structural Analysis	3	0	0	3	3
2	PCCV-612	Soil Mechanics	3	0	0	3	3
3	OECV-611	Open Elective-1	3	0	0	3	3
4	OECV-612	Open Elective-2	3	0	0	3	3
5	PECV-611	Professional Elective-1	3	0	0	3	3
6	PCCV-613	Structural Analysis lab	0	0	2	2	1
7	PCCV-614	Soil Mechanics	0	0	2	2	1
8	HSMC-603	Engineering Economics and Entrepreneurship	3	0	0	3	3
		Total	18	0	4	22	20

Semester-V-B

	EAA-611+ A/B/C)	Extra Academic activity Group A/B/C	-	-	-	-	1 (S/US)
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Semester-VI-A

S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PCCV-621	Water and Waste Water Engineering	3	0	0	3	3
2	PCCV-622	Design of Steel structures	3	1	0	4	4
3	OECV-621	Open Elective-3	3	0	0	3	3
4	OECV-622	Open Elective-4	3	0	0	3	3
5	PECV-621	Professional Elective-2	3	0	0	3	3

6	PCCV-623	Water and Waste Water Engineering lab	0	0	2	2	1
7	HSMC-601	Technical Communication	2	0	0	2	2
8	HSMC-602	Technical Communication Lab	0	0	2	2	1
		Total	17	2	4	22	20

Semester-VI-B

1	TPID-621	Industrial Training 04 weeks	0	0	160	160	2(S/US)
2	EAA-621+ A/B/C)	Extra Academic activity Group A/B/C	-	-	-	-	1 (S/US)

Semester-VII

S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PCCV-711	Irrigation Engineering	3	1	0	4	4
2	PCCV-712	Construction Management	3	0	0	3	3
3	OECV-711	Open Elective-5	3	0	0	3	3
4	PECV-711	Professional Elective-3	3	0	0	3	3
5	PECV-712	Professional Elective-4	3	0	0	3	3
6	PCCV-713	Computer-Aided Civil Engineering Design Lab	0	0	4	4	2
7	PRCV-711	Project Stage I and Seminar	0	0	4	4	2
		Total	15	1	8	24	20

Semester-VIII

S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PECV-721	Professional Elective-5	3	0	0	3	3
2	PECV-722	Professional Elective-6	3	0	0	3	3
3	PRCV-721	Project Stage II	0	0	12	12	6
		Total	6	0	12	18	12

OR

S No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	INID-721	Internship in Industry	0	0	40	40	6
2	PRCV-721	Project Stage II	0	0	12	12	6
		Total	0	0	52	52	12

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List of Open Electives

OECV-611	Open Elective- 1
OECV-611A	Building Material and Construction
OECV-611B	Disaster Preparedness & Planning
OECV-612	Open Elective- 2
OECV-612A	Sustainable Construction Methods
OECV-612B	Road Safety
OECV-621	Open Elective- 3
OECV-621A	Solid and Hazardous Waste Managements
OECV-621B	Construction equipment and Automation
OECV-622	Open Elective- 4
OECV-622A	Repairs & Rehabilitation of structure
OECV-622B	Ground Improvement Techniques
OECV-711	Open Elective- 5
OECV-711A	Construction Management
OECV-711B	Environment Law and Policy

List of Professional Electives

PECV-611	Professional Elective- 1
PECV-611A	Advanced Surveying
PECV-611B	Rock Mechanics
PECV-621	Professional Elective- 2
PECV-621A	Transportation Engineering II
PECV-621B	Ground Improvement Techniques
PECV-711	Professional Elective- 3
PECV-711A	Advanced Construction Materials and Techniques
PECV-711B	Advanced Concrete Design
PECV-712	Professional Elective- 4
PECV-712A	Seismic Resistant Design of Structures
PECV-712B	Advanced Steel Structures Design
PECV-721	Professional Elective- 5
PECV-721A	Foundation Engineering
PECV-721B	Disaster Preparedness & Planning
PECV-722	Professional Elective- 6
PECV-722A	Advanced Concrete Technology
PECV-722B	Pre-Stressed Concrete









Title of the course : **Engineering Mathematics-I**
Subject Code : **BSMA - 401**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

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

CO1: Learn about the basic concepts of Mathematics.

CO2: Understand various rules of Mathematics and how it is applied on solve different equations.

CO3: Understand the behavior of differential equations and integration.

CO4: Learn about the mechanism different formulas derivations and theorem.

CO5: Get knowledge about complex matrix, transformations, theorem and their properties.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	2	2	2	2	3	2	2	2	2	-	-	-
CO2	3	1	3	1	1	3	3	3	3	2	3	3	1	-	1
CO3	3	3	3	3	1	2	1	1	3	2	3	2	-	-	-
CO4	3	1	3	1	3	2	2	2	2	2	2	2	1	2	1
CO5	3	3	3	3	1	3	1	1	3	2	2	3	-	1	1
Avg.	3	1.8	3	2	1.6	2.4	1.8	2	2.6	2	2.4	2.4	1	1.5	1

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Matrices	Elementary transformations. Row reduced Echelon forms. Rank of a matrix. Normal form. Linearly dependent and independent vectors. System of linear equations. Linear transformations. Eigen values and eigenvectors. Properties of eigenvalues. Reduction to diagonal form. Verification of Cayley-Hamilton Theorem and its use for finding inverse of a matrix. Idempotent matrices. Complex matrices.	15
	Solid Geometry	Cartesian co-ordinate system. Distance formula. Section formulae. Direction ratios and direction cosines. Equation of a plane. Equations of a straight line. Condition for a line to lie in a plane. Coplanar lines. Shortest distance between two lines. Intersection of three planes. Equation of a sphere. Tangent plane to a sphere. Equations of a cone and a cylinder.	15
Unit-2	Differential equation	Solution of differential equation by variable separable method, homogeneous differential equation of first order and their solution, Exact differential equation.	14

Rehman, Pooja, J.S., S., A. K. S., Shubh, Rajinder, J.S., S.

	Linear differential equations	Solution of linear differential equation of first order. Reducible to linear differential equation. Higher order linear differential equation with constant coefficients, complementary function and particular integral. Method of variation of parameters. Cauchy's and Legendre's equations.	16
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Total=60

Recommended Books:

1. R.K. Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishers.
2. Denial A Murray, Elementary Course in Differential Equations, Longman.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited.
4. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill.

Revised by       

Title of the course : **Applied Chemistry**
Subject Code : **BSCH-401**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

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

CO1: Learn about the basic concepts of Chemistry.

CO2: Understand various materials and their properties.

CO3: Understand the behavior of different salt solution.

CO4: Learn about the mechanism of using different chemistry testing equipment's.

CO5: Get knowledge about electrolyte behaviour and their properties.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	1	1	2	2	1	2	2	1	2	1	3
CO2	3	1	3	1	1	1	1	3	2	2	1	2	1	-	1
CO3	3	3	3	3	1	1	2	1	3	2	2	1	-	2	-
CO4	3	1	3	1	3	1	2	2	2	3	3	1	1	2	1
CO5	3	3	3	3	1	1	1	1	1	1	1	3	-	1	1
Avg.	3	1.8	3	1.8	1.4	1	1.6	1.8	1.8	2	1.8	1.8	1	1.5	1

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Electro-analytical Chemistry	Conductivity of electrolytes- Specific, molar and equivalent conductivity, Nernst equation for electrode potential, EMF series, hydrogen electrode, calomel electrode, glass electrode, Electrolytic and galvanic cells, cell EMF, its measurement and applications, reversible and irreversible cells, concentration cell, electrode (hydrogen gas electrode) and electrolyte concentration cell, concentration cell with and without transference. Potentiometry: Principle, instrumentation and applications.	09
	Fuels	Classification, examples, relative merits, Solid Fuels: Coal, Proximate and Ultimate analysis of coal. Gross and Net Calorific Value, Determination of calorific value by Bomb Calorimeter Carbonization process, Low and High Temperature Carbonization. Liquid fuels: Cracking, Thermal and Catalytic Cracking, Synthetic petrol, Knocking, Antiknocking, Octane number, Cetane Number. Antiknocking agents. Gaseous fuels: Biogas, LPG and CNG. Determination of calorific value by Junker's Calorimeter. Flue gas analysis by Orsat's apparatus, problems.	10

24/08/2025 *Pragya* *PS* *W* *Re* *Shubh* *Pajinder* *h* *g*

	Surface Chemistry	Adsorption, chemisorption and physisorption, application of adsorption of gases on solids. Langmuir's adsorption isotherm, Freundlich's adsorption isotherm, BET theory of multi-layer adsorption (qualitative), adsorption chromatography. Colloidal particles, surfactants, micelles. Enzyme catalysis, Criteria for choosing catalyst for industrial processes.	09
Unit-2	Engineering Materials	Abrasives – Moh's scale of hardness – natural abrasives (diamond, corundum, emery, garnets and quartz) – synthetic abrasives (silicon carbide, boron carbide) – refractories – characteristics – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina magnesite and zirconia bricks.	10
	Lubricants	Classification of lubricant, lubricating oils, semisolid lubricants, solid and synthetic lubricants. Properties of lubricating oils (viscosity, flash and fire points, cloud and pour point, Iodine Value, Acid Value, R. M. Value, mechanical stability and saponification number).	07

Total=45

Recommended Books:

1. P. C. Jain & M. Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
3. F.W. Billmayer. Textbook of Polymer Science. 3rd Edn, Wiley. N.Y. 1991.
4. C. N. Banwell& E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn, Tata Mc Graw-Hill Edition, 1995.
5. S. S. Dara, S. S. Umare, A Text Book of Engineering Chemistry, S. Chand Publishing, 2011.
6. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Chapman and Hall, London, 1996.
7. Engineering Chemistry by B. Sivasankar, Tata Mcgraw Hill
8. Engineering Chemistry by A. Mallick, Viva Books, 2008.
9. Organic Chemistry by J. Clayden, Nick Greeves, S. Warren, Oxford Press 2012.
10. Levine, Physical Chemistry, 5/e (7th reprint), Tata McGraw Hill, 2006.
11. Inorganic Chemistry, Principle, structure and reactivity, J.E. Huheey, E.A. Keitler, R.L. Keita, O.K. Medhi, Pearson Education, 4th Ed.
12. Chemistry, J.E. Mcmerry and R.C. Fay, 5th Ed., Pearson Education, 2008

Robert Page 28 8 ~~8~~ Fe^4 Study Paymaster and 1/2

Title of the course

: Elements of Mechanical Engineering

Subject Code

: ESME - 401

L	T	P	Credits	Weekly Load
2	1	0	3	3

Course Outcomes:

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

CO1: Learn about the basic concepts of thermodynamics.**CO2:** Understand various laws of thermodynamics and how it is applied on various engineering devices.**CO3:** Understand the behavior of solids under various types of loads.**CO4:** Learn about the mechanism of different machines and its applications.**CO5:** Get knowledge about properties of engineering materials and its industrial applications.**Pre-requisite knowledge:**

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	3
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	2	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	1	2	-
CO4	3	3	2	3	1	2	1	2	1	3	1	2	1	2	1
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	1	1
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1	1.8	1.5

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Basic Concept of Thermodynamics	Definition, Thermodynamic system, boundary and surroundings, Thermodynamic property, Thermodynamic processes, Thermodynamic cycle and its concept, Energy and its forms, Ideal gas and characteristic gas equation, Zeroth law of thermodynamics.	06
	First Law of Thermodynamics and its Applications	Definition, Essence and corollaries of the first law, expressions for first law applicable to a process and cycle, concept of internal energy, enthalpy, total energy, specific heats, Closed and open systems, analysis of non-flow and flow processes for an ideal gas under constant volume, constant pressure, constant temperature, adiabatic and polytropic conditions, Analysis of free expansion and throttling processes, analysis of first law to steady flow energy equation and its applications to various engineering devices.	09

	Second Law of Thermodynamics	Limitations of first law, statements of second law and their equivalence, heat engine, heat pump and refrigerator, Philosophy of Carnot cycle and its consequences, Carnot theorem for Heat engine, refrigerator and heat pump, Clausius inequality, philosophy and concept of entropy, Third law of Thermodynamics.	09
Unit-2	Mechanics of Solids	Introduction, stress and strain, Hook's Law, longitudinal and lateral strain, Poisson's ratio, Stress strain diagram for ductile and brittle materials, Factor of safety, strain energy and resilience, Sudden and impact load, Stresses in bars, Thermal stresses, Elastic constants and their significance, relations between Elastic constants.	18
	Mechanism and Simple Machines	Introduction, Mechanisms and their concept, Definition of element, link, kinematic chain, mechanism, machine, Examples of mechanisms and their applications, Concept of Basic machines, Law of Lifting Machine, Different systems of pulleys and wheels.	08
	Engineering Materials	Materials and Engineering, Classification of Engineering Materials, Mechanical Properties of Engineering Materials, Various properties and Industrial applications of metals (ferrous: cast iron, tool steels, stainless steels and non-ferrous: Aluminum, brass, bronze), polymers, ceramics, composites, smart materials, Conductors, Semiconductors and insulators.	08

Total=48**Recommended Books:**

1. Nag P.K. Engineering Thermodynamics, Mc. Graw Hill.
2. Yadav R., Thermodynamics and Heat Engines, Central Publishing House, Allahabad
3. Singh V.P., Theory of Machines, Dhanpat Rai and Company, New Delhi.
4. Jindal U.C., Engineering Mechanics, Part-I, Galgotia Publications Pvt.Ltd., New Delhi.

Title of the course : **Workshop Technology and Practice**
Sub Code : **ESME – 402**

L	T	P	Credits	Weekly Load
1	0	0	1	1

Course Outcomes:

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

CO1: Basic concepts of workshop processes.

CO2: Understand various formation equipment and how it is applied on various engineering application.

CO3: Learn about the mechanism of different machines and its applications.

CO4: Understand the behavior of foundry, carpentry tools and their use.

CO5: Differentiate properties of engineering materials and its industrial applications.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	1	3
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	2	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	2
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.6	1.6	1.8

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Sheet Metal	Introduction to sheet metal work; GI sheets, aluminium, tin plate, copper, brass etc, Hand tools used in sheet metal shop like steel rule, vernier calipers, micrometer, sheet metal gauge etc., scribe, divider, punches, chisels, hammers, snips, pliers, stakes, rivets etc., Operations -shearing, bending, drawing, squeezing etc.	06
	Pattern Making	Introduction to pattern making, moulding and foundry practice. Pattern materials like wood, cast iron, brass, aluminium, waxes etc., different types of patterns, pattern allowances.	06
	Foundry	Introduction to casting process, core-boxes, core prints, hand tools-shovel, riddle, rammer, trowel, slick, lifter, sprue pin, bellow, mallet, vent rod, pouring weights etc., moulding sands-green sand, dry sand, loam sand, facing sand etc., grain shape and size, properties of moulding sand, sand preparation and testing etc., Gating Systems-requirements and functions, Functions of risers, Riser and directional	08

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		solidification. casting- permanent mould casting, centrifugal casting, etc.	
Unit-2	Carpentry	Introduction to wood working, Types of wood, seasoning methods, Marking and Measuring Tools-rule, try square, marking gauge, mortise gauge etc. Cutting Tools-rip saw, tenon saw, firmer chisel, mortise chisel, iron jack plane, wooden jack plane etc., Drilling Tools-braces, drill bits etc., Striking Tools-hammers, mallet etc., Holding Tools-bench vice, G-cramp etc., Miscellaneous Tools-rasps, files, screw driver, pincer etc.; Operations-marking, sawing, planning, chiseling, boring, grooving etc., Joints- Corner joints, Tenon and Mortise joint, Bridle cross-joint.	06
	Fitting	Introduction to fitting, Tools used in fitting -bench vice, hammers, chisels, files-flat file, square file, half round file, round file, knife edge file, scrapers, hacksaws, try squares, drill machine, drill bits, taps, dies etc, Operations-chipping, filing, scrapping, sawing, marking, drilling, tapping, dieing etc.;	06

Total: 32**Recommended Books:**

1. Hajra Choudhury, Hazra Choudhary and Nirjhar Roy, 2007, Elements of Workshop Technology, vol. I, Media promoters and Publishers Pvt. Ltd.
2. W A J Chapman, Workshop Technology, 1998, Part -1, 1st South Asian Edition, Viva Book Pvt Ltd.
3. P.N. Rao, 2009, Manufacturing Technology, Vol.1, 3rd Ed., Tata McGraw Hill Publishing Company.
4. Kaushish J.P., Manufacturing Processes, 2008, Prentice Hall India

Title of the course : English Communication and Soft Skills
Subject Code : HSMC - 401

L	T	P	Credits	Weekly Load
1	0	0	1	1

Course Outcomes:

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

CO1: Basic concepts of English skills and their use.

CO2: Understand various formation of sentences and how it is applied in general life.

CO3: Learn about the concepts of grammar for the formation of sentences.

CO4: Understand the behavior of words and their impact in writing.

CO5: Differentiate between tenses, voice command and phrases in sentence formation.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	-	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	-
CO4	3	3	2	3	1	2	1	2	1	3	1	2	1	2	1
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.33	2	1

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Communication Techniques	Importance of Communication, One-way and Two-way Communication, Essentials of Good and effective Communication, Barriers to Communication, Techniques to Overcome Barriers	04
	Writing Skills	Précis- writing; Essay- writing, Official e-mail writing	04
Unit-2	Report Writing	Reports and their importance, Types of Routine Reports along with their formats- Annual Confidential Report, Progress Report, Inventory Report, Inspection Report, Lab Report, Structure of Reports; Bibliography & References	04
	Grammar & Vocabulary	Tenses, Change of Voice, Change of Narration, Words often confused, Correct use of Prepositions, Use of Idioms and Phrases	04

Total=16

Rahul *Pooja* *SS* *W* *pe* *Shubh* *Pajinder*

Recommended Books:

1. Bhattacharya, Indrajit. An Approach to Communication Skills. Dhanpat Rai & Co.
2. Gibaldi, Joseph. MLA Handbook for Writers of Research Papers. MLA.
3. Sinclair, John. Collins Cobuild English Grammar. Collins.
4. Wren, P.C. & H. Martin. High School English Grammar & Composition. S. Chand & Company Ltd.
5. Sharma, R.C. & Krishna Mohan. Business Correspondence and Report Writing. Tata McGraw-Hill.

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Title of the course : Applied Chemistry Lab
Subject Code : BSCH-402

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Basic concepts of English skills and their use.

CO2: Understand various formation of sentences and how it is applied in general life.

CO3: Learn about the concepts of grammar for the formation of sentences.

CO4: Understand the behavior of words and their impact in writing.

CO5: Differentiate between tenses, voice command and phrases in sentence formation.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	1	2	1
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1	2	1

List of Experiments (10-14):

1. Introducing yourself.
2. Observing and analyzing your environment/ surroundings.
3. Collecting and Using Library Resources.
4. Giving Individual Presentations.
5. English Conversation Skills.
6. Group Discussions.
7. Extempore.
8. Debates.
9. Summarizing newspaper reports.
10. Role Plays.
11. Grammar exercises.
12. Finalization of Team Project Work.
13. Collecting Materials for Project Work & Finalization of Project.
14. Presentation of Project.

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Title of the course : **Elements of Mechanical Engineering Lab**
Subject Code : **ESME - 403**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Learn about the basic concepts of thermodynamics.

CO2: Understand various laws of thermodynamics and how it is applied on various engineering devices.

CO3: Understand the behavior of solids under various types of loads.

CO4: Learn about the mechanism of different machines and its applications.

CO5: Get knowledge about properties of engineering materials and its industrial applications.

Pre-requisite knowledge:

Pre-requisite knowledge:															
CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.33	1.75	1.4

List of Experiments:

1. To verify the Zeroth law of thermodynamics.
2. To study the COP's of Heat pump and Refrigerator.
3. To study the behaviour of ductile and brittle materials under tensile load.
4. To study different types of kinematics links and kinematic chains.
5. To find out the mechanical advantage, velocity ratio and efficiency of first system of pulley.
6. To find out mechanical advantage, velocity ratio and efficiency of a simple lifting machine.
7. To study the classification and properties of various engineering materials.

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Title of the course : **Engineering Drawing**
Subject Code : **ESME-404**

L	T	P	Credits	Weekly Load
0	0	4	2	4

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1:** Understand the universally accepted conventions, symbols and the methods of engineering drawing such as line, lettering, dimensioning, scales etc.
CO2: Draw dimensioned orthographic and isometric projections of engineering objects.
CO3: Develop and interpret the projection of planes, regular & sectioned solids, solids, surfaces.
CO4: To translate geometric and topological information of common engineering object.
CO5: To understand and visualize geometric objects more clearly by using AutoCAD.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	3	2	3	2	2	1	3	3	2	2	1	2	2
CO2	3	2	3	3	1	2	3	2	1	2	2	2	1	-	2
CO3	2	3	2	1	2	2	2	3	2	3	3	3	-	2	1
CO4	3	2	2	1	2	1	2	3	2	2	3	3	2	1	2
CO5	3	2	3	2	3	2	3	2	3	3	3	2	-	2	1
Avg.	2.4	2.2	2.6	1.8	2.2	1.8	2.4	2.2	2.2	2.6	2.6	2.4	1.33	1.75	1.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Introduction, Objectives, applications, Fundamentals of engineering drawing, Use and handling of different drawing instruments, title block, sheet sizes, first and third angle projections, orthographic projections.	04
	Lettering and Dimensioning	Free hand sketching of different types of lines in engineering drawing as per IS specifications, Free hand lettering (alphabet and numerals) - lower case and upper case, vertical and inclined at 75° in the ratio of 7:4, Notation of dimensioning, size and location dimensions, aligned and unidirectional systems of dimensioning, general rules for dimensioning, unit of dimensioning.	04
	Scales	Uses of scales, sizes of scale, representative fraction, construction of plain and diagonal scales.	06
	Projection of Points and Lines	Introduction on theory of projections and orthographic projections, projection of a point in different quadrants, projection of straight lines in different positions (all possible cases)	08

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Unit-2	Projection of Planes	Definition of plane, types of planes, traces of plane, projection of planes in different positions.	04
	Projection of Solids	Types of solids, projections of solids in simple and typical positions, introduction on sectioning of solids.	08
	Development of Surfaces	Introduction, Development of a right prism, cylinder, pentagonal prism, and a right pyramid, truncated pentagonal pyramid.	08
	AutoCAD	Introduction to AutoCAD software, familiarization with various AutoCAD toolbars, use of absolute, relative and polar coordinate system, creating new drawings using drawing tools, editing of drawings using modify commands, dimensioning of 2D and 3D drawings.	06

Total = 48

Recommended Books:

1. P S Gill, Engineering Drawing, Kataria and Sons, New Delhi
2. Harvinder Singh, Engineering Drawing & Computer Graphics, Dhanpat Rai, New Delhi.
3. R.K.Dhawan, Engineering Drawing, S. Chand & Co, New Delhi
4. N.D,Bhatt, Engineering Drawing, Charotar Publishing House

Title of the course : **Workshop Technology and Practice Lab**
 Subject Code : **ESME-405**

L	T	P	Credits	Weekly Load
0	0	4	2	4

Course Outcomes:

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

CO1: Basic concepts of workshop processes.

CO2: Understand various formation equipment and how it is applied on various engineering application.

CO3: Learn about the mechanism of different machines and its applications.

CO4: Understand the behavior of foundry, carpentry tools and their use.

CO5: Differentiate properties of engineering materials and its industrial applications.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	1	2
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	1	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.66	1.4	1.6

List of Practical's (10-14) jobs from the following list:

CARPENTRY SHOP

- Making of various joints
- Cross lap joint
- T-lap joint
- Corner lap joint
- Mortise and tenon joint
- Dovetail joint

FITTING SHOP

- Study and use of instruments in fitting shop, like vernier caliper, micrometer and height gauge etc.
- Exercise on simple operations viz. cutting, chipping, sawing, filling, drilling etc.

FOUNDRY SHOP

- Familiarization with different types of patterns and hand tools
- Preparations of green sand mould using single piece pattern.
- Preparations of green sand mould using split piece pattern on bench molding.
- Preparations of green sand mould using solid piece pattern by bedded molding.

PATTERN SHOP

- Familiarization with different tools and patterns in the shop

Rehmat *Pooja* *SS* *SN* *Re¹⁵* *Shubh* *Pajinder*

- Exercise on making of solid piece pattern.
- Exercise on making of split piece pattern.
- Exercise on making of cored pattern.

SHEET METAL SHOP

- Study the layout and different equipment used in sheet metal shop.
- Familiarization with different tools and processes in sheet metal shop
- Exercise on cutting, development, folding, bending, piercing, punching, parting, notching, slitting etc,
- Profile and circle cutting exercise.

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Title of the course : English Communication & Soft Skills lab
Subject Code : HSMC – 402

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Understand concepts of Communication

CO2: Improve Communication Skills

CO3: Understand Concept of Grammar and their usage

CO4: Participate effectively in group discussions, debates and job interviews

CO5: Make oral presentations and be able to use multimedia

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	1	1	2	1	1	1	1	1	2	2	2
CO2	3	1	3	1	1	1	1	1	1	1	1	1	2	3	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	1	2	1
CO4	3	1	3	1	3	1	2	2	1	1	1	1	1	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	3	2	2	2
Avg.	3	1.8	3	1.8	1.4	1	1.4	1.2	1	1	1	1.4	1.6	2.2	1.8

List of Activities of Lab (10-14):

1. Reflecting upon Self and Analyzing Environment.
2. Reading and Improving upon Vocabulary with the Help of Newspapers
3. Collecting and Using Library Resources.
4. Giving Individual Oral Presentations (Will Require Multiple Sessions)
5. English Conversation Skills and Speaking Practice
6. Group Discussions/Debates/Extempores
7. Summarizing a Given Short Story
8. Summarizing Newspaper Reports and Events
9. Role Plays/Mock Events
10. Grammar Exercises
11. Finalization of Team Project Work.
12. Collecting Materials for Project Work & Finalization of Project.
13. Presentation of Project.

Rahul *Pooja* *PS* *HW* *17* *Shubh* *Rajinder*

Title of the course : **Environmental Studies**
Subject Code : **MCCH-401**

L	T	P	Credits	Weekly Load
3	0	0	0	3

Course Outcomes:

After successful completion of course, the students should be able to:

CO1: Appreciate the need for Environmental integration for sustainable development.

CO2: Understand the importance of biodiversity and its conservation.

CO3: Recognize reasons for environmental pollution and remedial measures.

CO4: Familiarize with national and International environmental regulations

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1	2	3	3	3	1	2	1	2	2	2	2
CO2	2	2	2	1	2	3	3	3	1	2	1	2	2	1	2
CO3	2	2	2	1	2	3	3	3	3	2	1	2	2	1	2
CO4	2	2	2	1	2	2	3	3	1	2	1	2	3	2	3
Avg.	2	2	2	1	2	2.75	3	3	1.5	2	1	2	2.25	1.5	2.25

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction to Environmental Studies	Multidisciplinary nature of environmental studies, Scope and importance; Concept of sustainability and sustainable development.	02
	Ecosystems	What is an ecosystem? Structure and function of ecosystem; Energy flow in ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems(ponds, streams, lakes, rivers, oceans, estuaries)	06
	Natural resources: Renewable and Non-renewable resources	Land resources and landuse change; Land degradation, soil erosion and desertification Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal population. Water: Use and over exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).	06

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		Energy Resources: Renewable and Non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	
	Biodiversity and Conservation	Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. Conservation of biodiversity: I-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	06
Unit-2	Environmental Pollution	Environmental pollution: types, causes, effects and controls; air, water, soil and noise pollution, Nuclear hazards and human health risks. Solid waste management: control measures of urban and industrial waste. Pollution case studies.	08
	Environmental policies and practices	Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture Environmental laws: Environment protection act; Air (Prevention and control of pollution) act, Wildlife protection act, Forest conservation act, International agreement: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights, and human wildlife conflict in Indian context.	07
	Human Communities and the Environment	Human population growth: Impacts on environment, human health and welfare. Resettlement and Rehabilitation of project affected persons; case studies. Disaster management: floods, earthquake, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (example CNG vehicles in Delhi)	06
	Field work	Visit to an area to document environmental assets: river/forest/flora/fauna etc. Visit to a local polluted site: urban/rural/industrial/ agriculture. Study of common plants, insects, birds and basic principle of identification. Study of simple ecosystems-pond, river, Delhi ridge etc.	05

Total=46

Recommended Books:

1. Carson, R.2002. Silent Spring, Houghton Mifflin Harcourt.
2. Gadgil, M & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Glesson, Band Low, N.(eds) 1999. Global Ethics and Environment, London, Routledge.
4. Glerick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev, Environment& security. Stockholm env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gaery K. Meffe and Carl Ronald Caroll. Principles of conservation Biology. Sunderland: Sinauer Associates,2006.
6. Grumbine, R. Edward, and Pandit,M.K. 2013. Threats from India's Himalaya dams. Science,339:36-37

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Rajinder

Title of the course : **Engineering Mathematics II**
Subject Code : **BSMA-402**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Upon completion of this course, students will learn:

CO1: The mathematical tools needed in evaluating multiple integrals and their usage.

CO2: The effective mathematical tools for the solutions of differential equations that model physical processes

CO3: The tools of differential and integrations of functions of a complex variable that are used in various techniques dealing engineering problems.

CO4: Laplace transform and its applications to the solution of differential equations.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	3	2	3	3	2	2	2	1	2
CO2	3	3	3	3	2	2	3	2	3	3	2	2	2	1	2
CO3	3	3	3	3	2	2	3	2	3	3	2	2	1	1	1
CO4	3	3	3	3	2	2	3	2	3	3	2	2	2	1	1
Avg.	3	3	3	3	2	2	3	2	3	3	2	2	1.75	1	1.5

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Multivariable Calculus (Integration)	Multiple Integration: Double integrals (Cartesian and polar), Change in order of Integration in double integrals, Change of Variables (Cartesian and polar). Applications: area and volumes. Triple Integrals (Cartesian), Simple applications involving cube, sphere and rectangular parallelopiped.	7
	Ordinary Differential Equations	Exact, Linear and Bernoulli's differential equations, Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.	6
	Laplace Transform	Laplace transform of elementary functions, properties of Laplace transform, transform of derivatives and integrals, inverse Laplace transform, Convolution theorem, Solution of ordinary differential equations using Laplace transform, Unit step function and unit impulse function, their Laplace transforms.	8

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Unit-2	Complex Variable-Differentiation	Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate. Elementary analytic functions (exponential, trigonometric, logarithm) and their properties. Conformal mapping.	8
	Complex Variable-Integration	Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series. Cauchy residue theorem (without proof), Residue theorem and its applications to real integrals: Integration around unit circle, Integration over semi-circular contours.	9
	Vector Integration	Line, surface and volume integrals. Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.	7

Total=45

Recommended Books:

1. G.B. Thomas and R.L.Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W.E.Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems. 9thEdn., Wiley India, 2009.
4. S.L.Ross, Differential Equations, 3 Ed. Wiley India, 1984.
5. E.A Coddington, An Introduction to Ordinary Differential Equations, Prentice hall India, 1995.
6. E.L. Ince. Ordinary Differential Equations, Dover Publications, 1958.
7. J.W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw-Hill, 7thEdn., 2011.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

Title of the course : Applied Physics
Subject Code : BSPH-401

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

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

CO1: Understand the basic knowledge about waves and oscillations, Quantum mechanics, Laser and fibre optics, Electronic, Dielectric, magnetic and superconducting properties of materials and their applications.

CO2: Know the conceptual physics and its use in solving the physical problems.

CO3: Apply the principles/laws of physics for various engineering applications.

CO4: Describe the acquired knowledge of physics in his /her words.

CO5: Identify the reasons for physical happenings.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	1	1	2	2	3	2	1	3	2	2	2
CO2	3	3	3	2	3	2	2	1	2	1	2	2	1	1	1
CO3	3	1	2	1	1	3	3	3	3	2	3	3	2	1	2
CO4	3	3	1	1	1	2	2	2	2	3	1	1	1	2	1
CO5	2	1	3	1	1	2	3	2	2	2	2	2	2	1	1
Avg.	2.8	1.8	2	1.2	1.4	2	2.4	2	2.4	2	1.8	2.2	1.6	1.4	1.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Waves and Oscillations	Simple harmonic motion, damped and forced simple harmonic oscillator, Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance.	08
	Quantum Mechanics	Need of quantum mechanics, de-Broglie hypothesis, wave packet; particle, group and phase velocities and their relationships, properties of wave function, Schrödinger's time independent and time dependent wave equations, energy and momentum operators, Eigen values and Eigen functions, expectation values of physical quantities (position, momentum and energy), application of time	08

Radhika, Raj, AS, Re²³, Shubh, Rajinder Singh, K. S.

		independent wave equation for a particle in a box (one dimension).	
	Lasers & Fibre Optics	Absorption of radiation, spontaneous and stimulated emission of radiation, Einstein's coefficients, basic requirements of laser system - population inversion, optical pumping; Helium-Neon and Ruby lasers, Applications of laser, basic theory and physical structure of optical fiber, acceptance angle and numerical aperture, fiber materials, types of fibers, losses in optical fibers and basic ideas about optical sensors.	08
Unit-2	Electronic Materials	Free electron theory of metals, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-penny model (to introduce origin of band gap), Energy bands in solids, $E \sim k$ diagram, Brillouin zone and effective mass, direct and indirect band gaps, Distinction between metals, semiconductors and insulators.	08
	Dielectric properties of materials	Introduction of dielectric materials, polar and non-polar dielectric, basic concept of polarization, Different types of polarization, polarizability, temperature and frequency dependence of polarizability, Clausius-Mossotti relation, dielectric breakdown, dielectric loss, ferroelectric and piezoelectric materials and their applications.	06
	Magnetic materials and Superconductivity	Origin of magnetism, basic idea of diamagnetic, paramagnetic, ferromagnetic and ferrite materials, Soft and hard magnetic materials, magnetostriction, magnetic anisotropy and applications of magnetic materials. Superconductivity, Introduction, type I and type II superconductors, Meissner's effect, isotope effect, effects of magnetic field, London's equations, penetration depth, specific heat, BCS theory (qualitative idea), high temperature superconductors, applications of superconductivity.	10

Total=48

Recommended Books:

1. The physics of vibrations and waves, H. J. Pain, Wiley, 2006
2. Engineering Physics, H K Malik and AK Singh, Tata McGraw Hill
3. Concepts of Modern Physics, A. Beiser, Tata McGraw Hill
4. Introduction to Solids, L V Azaroff, Tata McGraw Hill
5. Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd.
6. Laser theory & Applications, K Thygrajan, A K Ghatak, Mc Millan India Ltd.
7. Materials Science, M S Vijaya, G Rangarajan, Tata McGraw Hill
8. Quantum Mechanics, D. J. Griffiths, Pearson Education

Title of the course : **Elements of Electrical Engineering**
 Subject Code : **ESEE-401**

L	T	P	Credits	Weekly Load
2	1	0	3	3

Course Outcomes:

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

CO1: Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits.

CO2: Formulate and analyze electrical circuits.

CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.

CO4: Identify and select various electrical machines according to the applications.

CO5: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	1	1	1	1	2	2	1	3	1	2	2
CO2	2	3	1	1	1	1	1	1	2	1	1	2	1	1	2
CO3	3	1	1	1	1	1	1	1	2	1	1	3	3	1	1
CO4	3	2	1	1	1	1	1	1	2	2	1	1	2	1	2
CO5	1	1	1	1	1	3	1	3	2	1	1	2	2	2	1
Avg.	2.4	1.6	1	1	1	1.4	1	1.4	2	1.4	1	2.2	1.8	1.4	1.6

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Basic Element	Concepts of electric charge, current and electromotive force, potential and potential difference; conductor, semiconductor insulator and dielectric, electrical power and energy; basics of instruments used for measuring current, voltage, power and energy, methods and precautions, introduction to digital measuring instruments.	6
	Concepts of DC	Ohm's law, resistance, and color coding; capacitance and inductance, their ratings; effects of temperature on resistance, series and parallel connection of resistance, capacitances, Kirchhoff's laws and applications, network theorems	6
	AC Fundamentals	Concept of alternating voltage and alternating current, difference between AC and DC, various terms related with AC waves; RMS and average values, concept of phase difference and phasor, single phase and three phase supply; alternating voltage applied to pure	6

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		resistance, pure inductance, pure capacitance and their combinations, concept of impedance and power in AC circuit.	
	Three phase AC	Phasor representation of three phases, star and delta connections, inter-relation between phase and line values of voltage/current, power measurement in three phase system.	6
Unit-2	Electromagnetic Induction	Concept of magnetic field, magnetic flux, reluctance, magnetomotive force (MMF), permeability; self and mutual induction, basic electromagnetic laws, effects on a conductor moving in a magnetic field, various losses in magnetic circuits.	6
	Electrical Machines	Elementary concepts and classification of electrical machines, common features of rotating electrical machines, basic principle of a motor and a generator, need of starters and their classifications. transformer- classification, principle of operation, construction, working and applications.	9
	Basic Electrical Installation and Protection	Basic testing and faults diagnosis in electrical systems, oscilloscopes, signal generators etc. basics of various protection and safety devices e.g. fuses, earthing, miniature circuit breaker (MCB) and earth leakage circuit breaker (ELCB) and their applications, replacement of different passive components e.g. lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays.	9

Total=48

Recommended Books:

1. Edward Hugh, Electrical Technology, Pearson Education
2. D P Kothari & I J Nagrath, Basic Electrical Engineering, Tata McGraw Hills
3. D P Kothari & I J Nagrath, Electrical Machines, Tata McGraw Hills
4. S K Bhattacharya, Electrical Machines, Tata McGraw Hills
5. B.L. Thereja, A Textbook of Electrical Technology, S Chand; Twenty Third edition, 2002.

Revised Page 28 by ~~Re~~²⁶ Shukla Rajinder Singh

Title of the course : Elements of Computer Engineering
Subject Code : ESCS-401

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Get acquainted with basics of computer system along with its various components
CO2: Know about various operating systems and memory
CO3: Study the C programming basics and learn the concept of operators
CO4: Understand the concept of decision statements and loops
CO5: Learn the use of functions, pointers, arrays, structures, union etc. For modular programming

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	3	2	3	1	1	1	3	3	2	2	1	2	2
CO2	3	2	3	3	1	1	1	1	1	2	2	2	1	2	2
CO3	2	3	2	1	2	1	1	1	2	3	3	3	2	1	1
CO4	3	2	2	1	2	1	1	1	2	2	3	3	1	2	2
CO5	3	2	3	2	3	1	1	1	3	3	3	2	2	3	1
Avg.	2.4	2.2	2.6	1.8	2.2	1	1	1	2.2	2.6	2.6	2.4	1.4	2	1.6

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Introduction and characteristics of computer system, Generations, Classifications, Applications, Central Processing Unit, Memory, I/O devices, Introduction to operating system and its types, Algorithm, Flow chart.	04
	C Programming Basics	Basic program construction, Structure of a C program, Compilation process, pre-processor directives, Comments, Data types, Type conversions, Operators - arithmetic, Relational, Logical, Conditional, Increment/decrement, Library functions, Header files.	04
	Loops and Decision Statements	For loop, while loop, do loop, Various forms of if statement, switch statement, break statement, continue statement, go to statement.	04
	Functions	Defining functions, Passing arguments to functions, Returning values from functions, Reference arguments and Storage classes.	04
Unit-2	Pointers	Pointers, Pointers to pointers, Declaring and initializing pointers, Pointer expressions, Pointers and arrays, Pointers and strings.	04

Arrays	Arrays and strings, Declaring an array, Initializing arrays, Accessing the array elements, Working with multidimensional arrays, Declaring and initializing string variables, String handling functions.	04
Structures and Union	Declaring and initializing a structure, Accessing the members of a structure, Nested structures, Array of structures, Using structures in functions, Pointers and structures, Declaring and initializing a union.	04
Files	Reading and writing to text and binary files, Character I/O, String I/O, File pointers, Error handling, Redirection, Command line arguments.	04

Total=32

Recommended Books:

1. Raja Raman V., Fundamentals of Computers, PHI.
2. Kernighan Brian W. and Ritchie, Dennis M, The C Programming language, Dorling Kingsley.
3. Balagurusamy, E., Programming in ANSI C, TMH Publications

Rahim, J. P. S. S. ~~Re~~ ²⁸ Re. Shukla Rajinder Singh, L.

Title of the course : Elements of Electronics Engineering
Subject Code : ESEC-401

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Outcomes:

After successful completion of course, the students should be able to:

CO1: Design simple combinational and sequential logic circuits.

CO2: Characterize semiconductors, diodes and transistors.

CO3: Apply the basics of diode and transistor to analyse the operation of electronic devices.

CO4: Design electronic circuits such as rectifiers, filters, voltage regulators, transistor amplifiers and operational amplifiers.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	1	1	2	2	1	2	2	1	2	1	3
CO2	3	1	3	1	1	1	1	3	2	2	1	2	1	-	1
CO3	3	3	3	3	1	1	2	1	3	2	2	1	-	2	-
CO4	3	1	3	1	3	1	2	2	2	3	3	1	1	2	1
Avg.	3	1.5	3	1.5	1.5	1	1.75	2	2	2.25	2	1.25	1	1.25	1.25

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Number system and codes Logic gates and flip flops	Decimal, binary, octal, and hexadecimal number system and their inter-conversions, Gray code, Excess-3 code. Definitions, symbols and truth table of NOT, OR, AND, NAND, NOR, XOR, XNOR gates, De-Morgan's theorems, realization of basic gates using universal gates; realization of simple Boolean equations using universal gates, introduction to K-map (3 variables), logic diagram, truth table and operation of latches and flip flops: RS, T, D, JK.	8
	Semiconductor devices	Semiconductor materials: Ge, Si, intrinsic and extrinsic semiconductors, p-type, n-type, p-n junction theory and diodes, its V-I characteristic, equivalent model, diode applications- half wave, full wave and bridge rectifier circuits, filter circuits: inductor filters, capacitor filters, L-section filters, π -section filters, comparison of filters, clippers and clampers, Zener diode, its characteristics and application as a voltage regulator, LED, photodiode.	8

Unit-2	Transistors	Bipolar junction transistor (BJT): basic operation, biasing, concept of dc load line and operating point selection, CB, CE, and CC configurations, BJT as an amplifier and switch, introduction to JFET and MOSFET: construction and operation.	8
	Operational amplifiers (Op-Amps.)	Introduction, basic characteristics of ideal and practical Op-Amp, IC741 pin configuration, Op-Amp in different modes: inverting and non-inverting amplifier, basic applications: adder, subtractor, voltage follower, multiplier, differentiator & integrator, instrumentation amplifier.	8

Total=32

Recommended Books:

1. Boylstad & Nashelsky, Electronic Devices & Circuits
2. Millman & Halkias, Integrated Electronics
3. Malvino, Electronic Principles
4. V.K. Mehta, Shalu Melta, Principles of Electronics
5. Donald L. Shilling & Charles Belowl, Electronic Circuits

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2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 260

Title of the course : Applied Physics Lab
Subject Code : BSPH-402

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

- CO1: Verify the theoretical formulations/ concepts of physics.
CO2: Know the art of recording the observations of an experiment scientifically.
CO3: Learn by doing.
CO4: Handle and operate the various elements/parts of an experiment.
CO5: Understand the importance of an experiment in engineering & technology

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	1	1	2	2	3	2	1	3	1	1	1
CO2	3	3	3	2	3	2	2	1	2	1	2	2	2	1	3
CO3	3	1	2	1	1	3	3	3	3	2	3	3	1	1	1
CO4	3	3	1	1	1	2	2	2	2	3	1	1	2	1	3
CO5	2	1	3	1	1	2	3	2	2	2	2	2	2	1	3
Avg.	2.8	1.8	2	1.2	1.4	2	2.4	2	2.4	2	1.8	2.2	1.6	1	2.2

List of Experiments:

- To determine the frequency of a tuning fork using sonometer.
- To determine the frequency of an electrically maintained tuning fork by Melde's experiment.
- To investigate resonance in forced oscillations and to find the spring constant.
- To verify the inverse square law of radiation using Photoelectric effect.
- To determine the value of Planck's constant and photoelectric work function of the material of the cathode using photoelectric cell.
- To determine the frequency of an unknown signal by drawing the Lissajous patterns for various frequency ratios and evaluate the phase difference between two sinusoidal signals applied to X and Y inputs of cathode ray oscilloscope.
- Determination of the value of e/m of an electron by helical method/Thomson method.
- To determine the numerical aperture (NA) of a given multimode optical fibre by using laser beam.
- To study the V-I characteristics of semiconductor diode.
- To find the band gap of the semiconductor material using diode in reverse bias.
- To determine the wavelength of He-Ne laser by diffraction method.

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12. Use of Michelson-Morley interferometer for determining the wavelength of He-Ne laser.
13. To find the Curie temperature of the given ferrite material.
14. To calculate the dielectric constant of the given dielectric material.
15. To determine the specific rotation of sugar solution using Laurent's half-shade polarimeter.

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Title of the course : Elements of Electrical Engineering Lab
Subject Code : ESEE-402

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits.

CO2: Formulate and analyze electrical circuits.

CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.

CO4: Identify and select various electrical machines according to the applications.

CO5: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	1	1	1	1	2	2	1	3	1	2	2
CO2	2	3	1	1	1	1	1	1	2	1	1	2	1	1	2
CO3	3	1	1	1	1	1	1	1	2	1	1	3	3	1	1
CO4	3	2	1	1	1	1	1	1	2	2	1	1	2	1	2
CO5	1	1	1	1	1	3	1	3	2	1	1	2	2	2	1
Avg.	2.4	1.6	1	1	1	1.4	1	1.4	2	1.4	1	2.2	1.8	1.4	1.6

List of Experiments: (At least 10 experiments)

1. Study of various passive components, measuring instruments, and their connections in electrical circuits.
2. Verification of Kirchhoff's current and voltage laws.
3. Measurement of voltage, current, phase angle, power and power factor in RL, RC and RLC circuits.
4. Implementation of various types of earthing.
5. Study of various types of protection devices e.g. fuses, Miniature circuit Breaker (MCB) and Earth leakage circuit Breaker (ELCB)
6. Verification of Faraday's laws and Lenz's law.
7. Starting and reversing of DC and AC motors with various types of starters.
8. Verification of turns ratio of transformer
9. Determination of voltage regulation of transformer.
10. Fault diagnosis and removal in general electrical connection /apparatus.
11. To study the breakdown strength of transformer oil.
12. To measure the Insulation resistance of cable
13. Demonstration of cut-out sections of various machines.

Rahul Singh *W* *Re* *33* *Shubh* *Rajinder Singh*

Title of the course : Elements of Computer Engineering Lab
Subject Code : ESCS-402

L	T	P	Credits	Weekly Load
0	0	4	2	4

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Solve basic mathematical problems using programming
- CO2: Demonstrate the use of loop statements to solve iteration problems
- CO3: Implement the concept of modular programming and recursion using functions
- CO4: Implementation of decision statements and loops
- CO5: Create a file and add, append retrieve data using file handling

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	3	1	1	3	3	3	2	2	1	2
CO2	3	3	3	2	2	2	1	1	3	3	3	2	1	1	1
CO3	3	3	3	2	3	2	1	1	3	2	3	3	2	1	1
CO4	3	3	3	3	3	3	1	1	3	2	3	3	1	1	1
CO5	3	3	3	3	3	3	1	1	3	3	3	3	1	1	1
Avg.	3	3	3	2.4	2.8	2.6	1	1	3	2.6	3	3	1.4	1	1.2

List of Experiments:

- WAP to find multiplication of two numbers.
- WAP to swap two numbers without using third variable.
- WAP to calculate temperature in Fahrenheit to Celsius using formula $C = (F - 32) / 1.8$.
- WAP to calculate Sum and Average of N numbers using sequence of statements.
- WAP to convert integer arithmetic to a given number of day and month using switch case.
- WAP to find maximum out of 3 numbers a, b & c using Control Statements (if, else, nested if, nested else).
- WAP to find minimum out of 3 numbers a, b & c using Control Statements (if, else, nested if, else).
- WAP to find whether entered number is palindrome or not.
- WAP to check entered number is even or odd.
- WAP to find whether entered year is leap year or not.
- WAP to find factorial of positive integer using for loop.
- WAP to print all the number between 1 to 100 which are divisible by 7 using the concept of loops.
- WAP to generate Fibonacci series up to n using loops.
- Write a program to calculate area of circle using function.
- Write an iterative function to calculate factorial of given number.
- Write a recursive function to calculate factorial of given number.

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17. WAP to find even & odd up to a given limit using the concept of array and loops.
18. WAP to reverse a string.
19. WAP to find addition of two matrix of $n \times n$ order using the concept of 2 dimensional array
20. WAP to find multiplication of two matrix of $n \times n$ order using the concept of 2 dimensional array.
21. WAP program to study the concept of structure.
22. WAP to implement the concept of switch and break statements.
23. WAP to implement the concept of continue statements.
24. WAP to create a data file, retrieve data from the file.

Note: The above-mentioned list of experiments is suggested list. Teacher may add more programs/ experiments as per requirement.

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Title of the course : **Elements of Electronics Engineering Lab**
Subject Code : **ESEC-402**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to:

CO1: Analyze and design various digital circuits using basic gates and flip flops.

CO2: Design practical circuits using semiconductor diodes.

CO3: Analyze various modes of transistors in different configurations.

CO4: Design circuits using transistors and Op-Amps.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	3	2	2	1	1	3	2	1	2	2	1	2
CO2	3	3	3	3	2	2	1	1	3	2	1	1	2	1	1
CO3	3	3	1	3	2	2	1	1	3	2	1	2	1	1	1
CO4	3	3	3	3	2	2	1	1	3	2	1	2	2	1	1
Avg.	3	2.5	2.5	3	2	2	1	1	3	2	1	1.75	1.75	1	1.25

List of Experiments:

1. Verification of the truth tables of basic gates, e.g., 7400, 7402, 7404, 7408, 7432, 7486.
2. Design all other gates using NAND and NOR gates.
3. Design S-R flip-flop using NOR/NAND gates.
4. Verify the truth table of J-K flip-flop (7476), D flip-flop (7474) and T flip-flop.
5. To observe and analyze V-I characteristics of PN junction diode.
6. To observe and analyze V-I characteristics of Zener diode.
7. Design and analysis of half wave rectifier with capacitor filter.
8. Design and analysis of center tap full wave rectifier with capacitor filter.
9. Design and analysis of bridge type full wave rectifier with capacitor filter.
10. Design and analysis of Zener as a voltage regulator.
11. To observe V-I characteristic of PNP and NPN transistor in common base configuration.
12. Design and analysis of Op-Amp as an inverting amplifier & non-inverting amplifier.
13. Design and analysis of Op-Amp as an integrator & differentiator.
14. To observe V-I characteristic of JFET.
15. To observe V-I characteristic of MOSFET.

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Title of the course : **Surveying-I**
Subject Code : **PCCV-511**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Understand the importance of surveying in Civil engineering
- CO2: Study the basic of linear/angular/direction measurements using chain/tacheometer/compass and theodolite and their applications
- CO3: Study the method of determination of height of points using various leveling method and tacheometer.
- CO4: Study the significance of Plane Table surveying in preparation of map and setting of different types of curves
- CO5: Study the determination of coordinates using satellite-based method

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	2	3	1	2	2	2	1	3	2	2	2
CO2	2	3	2	2	3	2	1	2	2	2	1	2	3	2	2
CO3	2	2	2	1	3	1	1	2	3	1	1	3	3	2	2
CO4	1	2	2	2	3	1	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2	2.4	2	2	2.8	1.8	1.2	1.8	2.6	1.8	1.4	2.8	2.8	2.2	2.4

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Surveying	Definition, classification of surveys, Principle, distorted or shrunk scales, precision in surveying.	4
	Chain Surveying	Types of chains, tapes, ranging-direct & indirect, chaining on sloping ground, mistakes in chaining, corrections for linear measurements. Reconnaissance, station selection, limiting length of offsets, field notes.	4
	Compass Traversing	Types of compasses, bearings, meridians, declination, dip of magnetic needle, bearing of lines from included angles, local attraction, closing error and its removal.	4
	Theodolite	Types of theodolites, measurement of angles, temporary and permanent adjustments, closed & open traverse, omitted measurements, consecutive and independent co-ordinates.	4

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		advantages and disadvantages of traversing closing error, Bowditch & Transit Rules	
	Leveling	Definitions of terms used in leveling, different types of levels, parallax, staff, temporary adjustments, bench marks, booking and reducing the levels, rise and fall method, line of collimation method, errors in leveling, permanent adjustments, corrections to curvature and refraction, setting out grades.	4
Unit-2	Contours	Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contour maps. Plane Table Surveying: Introduction to plane table surveying, principle, instruments, working operations, setting up the plane table, centering, leveling, Orientation, methods of plane table survey, two- and three-point problems, danger circle, Lehmann's Rules, errors.	5
	Tacheometry	Definitions and terms used in tacheometry, determination of constants, angular tacheometry with staff vertical and staff inclined, Merits and Demerits; Analytic lens, tangential method of tachometry, subtense method of tacheometry.	4
	Trigonometric Leveling	Definitions & terms, curvature & refraction Methods: direct & reciprocal, eye and object correction, coefficient of refraction.	3
	Curves setting	Definition, elements of a simple curve, different methods of setting out a simple circular curve, elements of a compound curve, reverse curves, transition curves, their characteristics and setting out, vertical curves, setting out vertical curves, sight distances.	4
	Total Station	Working principle and survey with total station.	3
	Global Positioning Systems (GPS)	Working principle, Types of GPS, Corrections, Application of GPS. DGPS-working principle.	3
	Digital Elevation model	Introduction and application	2
	Field astronomy	Introduction, basic principle, and application	2
	Remote sensing	Basic concepts, Principle, and applications Photogrammetry: Concepts and application for map preparation	2

Total=48

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Recommended Books:

1. Duggal, S.K., Surveying Vol I & II, Tata McGraw Hill
2. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol. I, II & III, Laxmi Publications
3. Agor, R., Surveying, Khanna Publishers
4. Bhavikatti, S.S. Surveying & Levelling Volume I & II; I K International Publishing House Pvt. Ltd
5. Surveying volume I and II: B C Punmia; Laxmi Publications
6. Engineering Surveying (Sixth Edition): W. Schofield; CRC Press
7. Text Book of Surveying: C.Venkataramiah; Orient Blackswan Private Limited - New Delhi
8. Introduction to GPS: The Global Positioning System: Ahmed El-Rabbany; Artech House Publishers

Rahul Day 28 Jan 39 Shikha Rajinder Singh

Title of the course : **Fluid Mechanics**
Subject Code : **PCCV-512**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

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

- CO1: Understand the basic terms used in fluid mechanics and its broad principles
- CO2: Estimate the forces induced on a plane/ submerged bodies
- CO3: Formulate expressions using dimensionless approach and able to determine design parameters by creating replica of prototype at appropriate scale.
- CO4: Apply the continuity, momentum and energy principles and design the pipelines used for water supply or sewage under different situation.
- CO5: Calculate drag force exerted by fluid on the body of varying shapes and able to minimize them and addressing problems in open channel (lined/ unlined) of different shapes and size optimally as per site condition.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	2	1	1	2	1	2	3	3	3	2
CO2	3	2	2	2	2	2	2	1	2	1	2	3	3	2	3
CO3	3	3	2	3	2	2	2	1	2	1	2	2	3	3	3
CO4	3	3	2	3	3	2	2	1	2	1	2	3	3	3	3
CO5	3	3	3	3	2	2	2	2	2	2	3	2	3	3	3
Avg.	3	2.6	2.2	2.6	2.2	2	1.8	1.2	2	1.2	2.2	2.6	3	2.8	2.8

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Definition of a fluid and its properties, Types of fluids.	5
	Fluid statics	Differential equation of pressure field, Pascal law, Measurement of fluid pressure, force on submerged surfaces, Buoyancy and Flotation.	6
	Fluid kinematics	Methods of describing fluid motion, Velocity and acceleration of a fluid particle, Type of fluid flows, Displacement of a fluid particle, Continuity equation, Velocity potential and stream function, Flow net.	8
	Fluid dynamics	Euler's equation; Bernoulli's equation; Momentum equation; Applications, Kinetic energy and momentum correction factors.	6

Unit-2	Flow through pipes	Energy losses, Hydraulic gradient line and total energy line, Concept of equivalent pipe, Pipes in series and parallel, Flow through a siphon, and Transmission of power.	8
	Flow measuring devices	Venturimeter, Orifice meter, orifice, Pitot tube, Time of emptying tanks of different cross-sections.	4
	Dimensional analysis	Methods of dimensional analysis, Model studies. Pumps and Turbines: Introduction to various types of pumps and turbines.	6
	Pumps and Turbines	Introduction to various types of pumps and turbines.	5

Total=48

Recommended Books:

1. Fluid Mechanics & Hydraulic Machines: Dr. R.K. Bansal; Laxmi Publications Pvt Ltd
2. Hydraulic and Fluid Mechanic by P.N. Modi & S.M. Seth; STANDARD BOOK HOUSE
3. Engineering Fluid Mechanics by R.J. Garde & A.G. Mirajgaoker; Nem Chand & Bros.; 3rd edition
4. Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Pitman; Prentice Hall; 4th edition
5. Fluid Mechanics: Streetes VL & Wylie EB; McGraw Hill Higher Education
6. Fluid Mechanics by Potter, Cengage Learning; Cengage Learning; 4th ed. edition
7. Theory and application of fluid Mechanics including Hydraulic Mechanics by K Subramanya; McGraw-Hill Education - Europe

Rohit, Pooja, SS, Jan, 41, Re, Shubh, Rajinder, P.H. S

Title of the course : **Building Materials and Construction**
Subject Code : **PCCV-513**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Identify different building components.

CO2: Understand concept of green buildings and materials

CO3: Characterize different materials used in construction along with their applications

CO4: Develop knowledge about physical and chemical properties along with advantages and disadvantages of materials used in construction.

CO5: Understand basic knowledge about installation of doors and window

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	2
CO2	2	3	2	2	3	2	1	2	3	2	2	2	3	3	2
CO3	2	2	2	1	3	1	1	2	3	1	1	3	3	3	2
CO4	3	2	2	2	3	1	1	1	3	2	2	3	3	2	3
CO5	2	3	2	2	3	2	1	2	3	2	2	2	3	3	2
Avg.	2.2	2.4	2	1.8	2.8	1.8	1	1.8	2.8	1.8	1.6	2.6	2.8	2.8	2.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Cement	Cements composition, types of cement, manufacturing of ordinary Portland cement, testing of cement, special types of cement, storage of cement.	4
	Stones	Classification, requirements of good structural stone, quarrying, blasting and sorting out of stones, seasoning of stone, deterioration of stones, common building stones of India.	4
	Brick and Tiles	Classification of bricks, constituents of good brick earth, harmful ingredients, manufacturing of bricks, testing of bricks. Tiles, Terra cotta, manufacturing of tiles and terra cotta, types of terra-cotta, uses of terra-cotta, AAC blocks, hollow concrete blocks.	5
	Mortars	Definition, proportions of lime and cement mortars, Classifications & Properties.	4

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	Concrete	Introduction, properties of concrete, water cement ratio, workability, compressive strength, grades, Production of Concrete: Batching, mixing, transportation, placing, compaction and curing of concrete, quality control of concrete, concrete mix design.	7
	Special Concrete	Light weight concrete, high strength concrete, mass concrete, waste material-based concrete, shotcrete, fiber reinforced concrete.	4
Unit-2	Admixtures and Super-plasticizers	Functions, classification, accelerating admixture, water reducing admixture, retarding admixture, air-containing admixture	4
	Timber	Classification of timber, structure of timber, seasoning of timber, defects in timber, characteristics of good timber	4
	Metals	Manufacture of steel, market forms of steel e.g., mild steel and HYSD steel bars, rolled steel sections. Thermo-Mechanically Treated (TMT) Bars.	4
	Introduction to building construction	Basic building components (Foundation, plinth, wall, sill, lintel, roof, doors, windows, ventilators, staircases, sunshades etc.), Role of materials in construction, green building materials, fire resistance materials.	4
	Miscellaneous Materials	Asphalt, Bitumen, insulating materials, materials for doors and windows, paints, Introduction to refractories, laminate, adhesives, graphene and carbon composites.	4

Total=48

Recommended Books:

1. Rangawala S.C. Engineering Materials Chortor Publishing House, Anand (1992).
2. Gambhir M. L., Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., New Delhi (2004).
3. Rangawala S. C., Engineering Materials, Charotar
4. S.K. Duggal Building Materials, New Age International Publications 2006.
5. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
6. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973

Title of the course : **Engineering Mechanics**
Subject Code : **ESME-501**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

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

CO1: Understand the importance of mechanics in the context of engineering.

CO2: Calculate and analyze the various forces acting on engineering component

CO3: Analyse the different principles to study the motion of a body, and concept of relative velocity and acceleration.

CO4: Analyse various forces acting on elements of truss

CO5: Identify the basic elements of a mechanical system and write their constitutive equations.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2	2	2	3	2	3	2	2	2	1	-
CO2	2	3	3	2	3	3	3	2	3	2	3	3	1	-	1
CO3	2	2	3	3	2	2	2	3	2	3	2	2	1	2	2
CO4	2	3	3	3	3	3	2	3	3	2	3	2	2	1	-
CO5	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
Avg.	2.4	2.6	2.8	2.6	2.6	2.4	2.2	2.6	2.6	2.4	2.4	2.2	1.4	1.5	1.33

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Fundamental of Mechanics	Mechanics and its relevance, Fundamental concept of mechanics and applied mechanics, idealization of mechanics, Basic dimensions and units of measurements, concept of rigid bodies, Laws of Mechanics	03
	Laws for Forces	Control Scalars and Vectors, Vector operations, Vector addition of forces, Force and its effects, characteristics of force vector, Bow's notation Force systems: Coplanar and Space force systems. Coplanar concurrent and non-concurrent forces. Free body diagrams	04
	Resultant and components of forces	Concept of equilibrium; Parallelogram law of forces, equilibrium of two forces; super position and transmissibility of forces, Newton's third law, triangle law of forces, different cases of concurrent, coplanar two forces systems, extension of parallelogram law and triangle law to many forces acting at one point.	04

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	Polygon law of forces	Triangle law to many forces acting at one point - polygon law of forces, method of resolution into orthogonal components for finding the resultant, graphical methods, special case of three concurrent, coplanar forces, Lami's theorem	04
	Moments & Couples	Concept of moment, Varignon's theorem, Principle of moments, Moment of forces about a specified axis, concept of couple - properties and effect, Moment of couple, Movement of force on rigid body, Resultant of force and couple system, Reduction of force and couple system, Parallel forces - like and unlike parallel forces, calculation of their resultant.	04
	Trusses	Simple trusses, analysis of simple truss, Method of Joints, Method of sections	04
Unit-2	Friction	Concept of friction, Characteristics of Dry friction, Laws of Coulomb friction, limiting friction, coefficient of friction; sliding friction and rolling friction, Belt friction, Ladder friction.	04
	Centre of gravity and Moment of Inertia	Concept of gravity, gravitational force, centroid and centre of gravity, centroid for regular lamina and centre of gravity for regular solids. Position of centre of gravity of compound bodies and centroid of composite area. CG of bodies with portions removed, Moment of Inertia: First and second moment of area; Radius of gyration, Moment of inertia of simple and composite bodies.	06
	Simple Lifting Machines	Concept of machine, mechanical advantage, velocity ratio and efficiency of a machine, their relationship, law of machine, Simple machines: Wheel and axle, pulley systems, Simple screw jacks	03
	Kinetics of a particle	Types of motion, linear motion with uniform velocity, uniform & varying acceleration, motion under gravity, motion of projectiles, concept of relative and resultant velocity. Newton's laws of motion, equation of motion for system of particles, D'Alembert's Principle, Motion of connecting bodies. Concept of momentum, Impulse momentum, Conservation of momentum and energy, Principle of work and energy	06
	Kinetics of a rigid body	Introduction, Equation of motion for a rigid body, Angular Motion of Rigid Bodies, D'Alembert's principle applied to bodies having linear and angular motion. Equation of dynamic equilibrium, Maximum acceleration and retardation of vehicles running on inclined planes.	06

Total=48

Recommended Books:

1. J. L. Mariani & L. G. Kraige , Engineering Mechanics. John Wiley & Sons
2. R. C. Hibbeler, Engineering Mechanics (Static & Dynamics), Prentice Hall
3. Beer & Johnston, Engineering Mechanics (Static & Dynamics), McGraw Hill
4. Boresi & Schmidt, Engineering Mechanics (Static & Dynamics), Cengage Learning
5. R. K. Rajput, Engineering Mechanics, Dhanpat Rai Publication, New Delhi
6. S. Rajshekharan, Engineering Mechanics, Vikas Publishing House , New Delhi

Rahul Rajput JS Sa $\frac{A}{K}^{46}$ Shukla Rajinder Singh, S

Title of the course : Principles of Management
Subject Code : HSMC-501

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: The scope of this paper is to familiarize students with the concepts of OB knowledge to management practices.
CO2: This course aims to provide insights necessary to understand behavioural processes at individual, team and organizational level
CO3: To enable students to learn how to influence the human behaviour in organisations.
CO4: To understand the behaviour of employees which affect the organisational environment.
CO5: To achieving higher productivity and accomplishing goals of the organization.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1	1	1	1	2	1	2	1	2	1	2	1
CO2	3	3	3	1	1	1	2	3	3	2	2	2	1	2	2
CO3	3	3	3	1	1	2	1	3	2	2	1	2	1	2	1
CO4	3	3	3	1	1	2	3	2	2	1	1	2	1	1	2
CO5	3	3	3	1	1	1	1	2	3	1	2	2	1	3	1
Avg.	3	3	3	1	1	1.4	1.6	2.4	2.2	1.6	1.4	2	1	2	1.4

Theory:

Unit	Course outlines	Lecture(s)
Unit-1	Definition of management, science or art, manager vs. entrepreneur; Types of managers' managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches, Corporate Social Responsibility	10
	Current trends and issues in management. Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.	12
Unit-2	Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.	14

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Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication. Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.	12
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Total=48

Recommended Books:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

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Title of the course : **Surveying-I Lab**
Subject Code : **PCCV-514**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

- CO1: Understand the concept, various methods and techniques of surveying
- CO2: Compute angles, distances and levels for given area
- CO3: Apply the concept of tachometry survey in difficult and hilly terrain.
- CO4: Select appropriate instruments for data collection and survey purpose
- CO5: Analyze and retrieve the information from remotely sensed data from GIS and GPS and analyze the geographical data

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.4	2.2	2	2.8	2	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

List of Experiments:

1. Measurement of distance/Offsets, ranging a line with Chain and tape.
2. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
3. Different methods of levelling, height of instrument, rise & fall methods.
4. Measurement of horizontal and vertical angle by theodolite.
5. Preparing a contour map.
6. Plane table survey, different methods of plotting, two point & three point problem.
7. Determination of height of an inaccessible object.
8. Setting out a transition curve, setting out of circular curves in the field using different methods.
9. Introduction of Total Station.

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Title of the course : **Fluid Mechanics Lab**
Subject Code : **PCCV-515**

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:

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

- CO1: Understand the basic terms used in fluid mechanics and its broad principles
- CO2: Estimate the forces induced on a plane/ submerged bodies and formulate expressions using dimensionless approach and able to determine design parameters by creating replica.
- CO3: Apply the continuity, momentum and energy principles and design the pipelines used for water supply or sewage under different situation.
- CO4: Calculate drag force exerted by fluid on the body of varying shapes and able to minimize them.
- CO5: Design and addressing problems in open channel (lined/ unlined) of different shapes and size optimally as per site condition.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	3	2	2	3	2	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.6	2.2	2.0	2.8	2.2	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

List of Experiments:

1. Verification of Bernoulli's Theorem
2. Calibration of venturimeter/orifice meter
3. Determine viscosity of a liquid by Redwood Viscometer
4. Determination of hydrostatic force and its location on a vertically immersed surface
5. Determination of friction factor for pipes of different materials
6. Determination of hydraulic coefficients of an orifice
7. Visualization of laminar and turbulent flow.

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Title of the course : **Building Material and Construction Lab**
Subject Code : **PCCV-516**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes: After successful completion of course, the students should be able to

CO1: Understand the relevance of different properties of constituent materials on properties of concrete.

CO2: Understand the behavior and durability aspects of concrete under different loading and exposure conditions.

CO3: Design of concrete mixes as per BIS specifications.

CO4: Understand various testing methods for concrete and their applicability.

CO5: Knowledge of special type of non-conventional concretes.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3	3	3	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	2	1	2	3	3	2	2
CO4	2	2	2	2	2	2	1	1	3	2	2	3	3	2	2
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.6	2.4	2.2	2.8	2.0	1.2	1.8	2.4	1.8	1.8	2.8	2.8	2.6	2.6

List of Experiments:

1. Tests on cement (fineness, consistency, initial and final setting time and strength test).
2. Tests on fine and coarse aggregates (gradation, specific gravity, water absorption).
3. Design of concrete mix for required grade of concrete.
4. Tests on fresh concrete (workability test).
5. Tests on hardened concrete (compressive strength, flexural strength and split tensile strength).

Rahul Singh *PS* *IN* *Re⁵¹* *Shubh* *Pajinder* *ht* *S*

Title of the course : **India Constitution**
Subject Code : **MCMH- 501**

L	T	P	Credits	Weekly Load
3	0	0	0	3

Course Outcomes:

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

CO1: History, formation and silent features of Indian Constitution.

CO2: Fundamentals Rights and Duties.

CO3: Directive Principle of State Policy.

CO4: Various Protections in respect of Life and Personal Liberty.

CO5: Various Rights pertaining to religion, cultural and education.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	3	-	3	2	-	-	2	-	2	-
CO2	-	-	-	-	-	3	-	3	2	-	-	2	-	2	-
CO3	-	-	-	-	-	3	-	3	2	-	-	2	-	2	-
CO4	-	-	-	-	-	3	-	3	2	-	-	2	-	2	-
CO5	-	-	-	-	-	3	-	3	2	-	-	2	-	2	-
Avg.	-	-	-	-	-	3	-	3	2	-	-	2	-	2	-

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction to Indian Constitution	Salient features of Indian Constitution, Nature of Indian Constitution-Unitary or Federal, Preamble of Constitution, Citizenship	10
	Fundamental Rights-I	Definition of State (Article-12), Laws inconsistent with Fundamentals Rights (Article-13), Right to Equality (Article 14-18)	10
Unit-2	Fundamental Right-II	Freedom of speech & Expression (Art 19), Protection in respect of conviction of offences (Art 20), Protection of Life & Personal Liberty (Art 21), Safeguards against arbitrary arrest & detention (Art 22)	10
	Fundamental Right-III	Right against Exploration (Art 23-24), Right to Freedom of Religion (Art 25-28). Cultural & Educational Right (Art 29-30). Right to Constitutional remedies(Art 32-35)	10

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	Directive Principles & Fundamental Duties	Directive Principles of State Policy (Art 36-51), Fundamental Duties (Art 51A), Basic Features of Constitution & Procedure for Amendment of Constitution	08
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Total = 48

Recommended Books:

1. N.Shukla, Constitution of India, Eastern Book Agency, 2014
2. P.Jain Indian Constitution Law, Lexis Nexis, 2013
3. D. Basu, Introduction to Indian Constitution, of India (20th Ed.2009)
4. M.Seervai, Constitutional Law of India, Universal Law Publishing Co. Reprint 2013
5. Glanville Austin, Indian Constitution -cornerstone of the Nations, Oxford University Press, 1999
6. M.Bakshi The constitution of India, Universal Law Publishing Co 2014
7. D.Basu shorter Constitution of India (14th Ed.2008, reprint 2010)

Rahul Poo 28 W 53 Shukla Rajinder Singh

Title of the course : Numerical and Statistical Methods
Subject Code : BSMA- 501

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

The course aims to shape the attitudes of learners regarding the field of statistics. Specifically, the course aims to motivate in students an intrinsic interest in statistical thinking and Instil the belief that statistics is important for scientific research.

Upon completion of this course, the student will be able to:

CO1: Understand the concept of errors in numerical methods.

CO2: Find the roots of equations using different methods and discuss the convergence of the solution.

CO3: Understand the concept of different operators and their applications in solving numerical differentiation and integration.

CO4: Solve numerically ordinary differential equations of first order.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	3	2	3	3	2	2	3	1	2
CO2	3	3	3	3	2	2	3	2	3	3	2	2	3	2	2
CO3	3	3	3	3	2	2	3	2	3	3	2	2	3	1	3
CO4	3	3	3	3	2	2	3	2	3	3	2	2	3	1	2
Avg.	3	3	3	3	2	2	3	2	3	3	2	2	3	1.25	2.25

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Errors and Solution of Equations	Errors in arithmetic operations and functions: Round-off error, truncation error, absolute error, relative error, percentage error. Intermediate value property, Descartes Rule of signs. Bisection method, Method of false position, Secant Method, Newton-Raphson method, Iteration method. Convergence of these methods. Gauss Elimination method (with and without partial pivoting). Jacobi, Gauss-Seidel methods.	10
	Finite Difference and Interpolation	Finite differences: forward, backward and central differences, Shift and averaging operators, Newton's forward, backward and divided difference interpolation formulae, Lagrange's formula.	6

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	Numerical differentiation, integration and solution of ODEs	Numerical differentiation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule, Simpson's one third and three-eighth rules. Error in integration. Solution of ODE of first order: Taylor series method, Picard's method, Euler method, Modified Euler's method and Runge-Kutta methods.	7
Unit-2	Curve fitting	Curve fitting by the method of least squares: fitting of straight lines, second degree parabolas and more general curves.	5
	Statistics	Measures of central tendency, measures of dispersion, coefficient of variation, relation between measures of dispersion, moments, skewness, kurtosis, Karl Pearson coefficient of correlation.	8
	Probability	Definition of probability, laws of probability, Baye's theorem, Random variable, Mathematical Expectation, Moment generating function, Probability distributions: Binomial, Poisson and Normal.	9

Total = 45

Recommended Books:

1. S.S. Sastry, Introductory Method of Numerical Analysis, PHI (2005).
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International (2007).
3. B. S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers, 2011.
4. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons (2014).
5. A. M. Goon, M. K. Gupta and B. Dasgupta, An Outline of Statistical Theory, Vol. I, World Press Pvt. Ltd (2013).
6. S. P. Gupta, Statistical Methods, S. Chand & Co., 43rd Edition, 2017

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Title of the course : **Solid Mechanics**
Subject Code : **PCCV-521**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Identify and quantify all forces associated with a static framework/ plane force systems.

CO2: Evaluate axial stresses and strains in various determinate and indeterminate structural systems.

CO3: Draw shear force diagram and bending moment diagram in various kinds of beams subjected to different kinds of loads.

CO4: Evaluate the different types of stresses (Bending/Shear) in flexural members.

CO5: Determine deformations and deflections in various kinds of beams.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	3	3	2	2	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	2	2	3	2	1	2	2	2	2	2	3	3	3
Avg.	2.6	2.6	2.0	2.0	2.8	2.0	1.0	1.8	2.4	1.8	1.6	2.6	2.8	2.6	2.8

Theory

Unit	Main Topics	Course Description	Lecture(s)
Unit-1	Introduction of equilibrium of bodies	Concept of Free-body diagrams and conditions of equilibrium of bodies, static determinacy.	8
	Axial Stress and Strain	Concept of stress, strain, elasticity and plasticity; one-dimensional stress-strain relationships; statically determinate and indeterminate problems, compound and composite bars	8
Unit-2	Shear Force and Bending Moment Diagrams	Types of load on beams, classification of beams; axial, shear force and bending moment diagrams: simply supported, overhanging and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment.	10
	Bending & Shear Stresses in beams	Derivation of flexural formula for straight beams, concept of centroid and second moment of area, bending stress	10

		calculation for beams of simple and built up sections, flitched beams. Shear stress formula for beams, shear stress distribution in beams	
	Deformations	Governing differential equation for deflection of straight beams having constant flexural rigidity, Double Integration, Macaulay's, Moment Area and Conjugate Beam method for determining slopes and deflection in beams.	8

Total=48

Reference Books:

1. Mechanics of materials, R. C. Hibbeler, Pearson, Tenth edition, 2016.
2. Mechanics of materials, F.P. Beer, E.R. Johnston, D. Mazurek, McGraw-Hill Higher Education, 2011.

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Title of the course : **Transportation Engineering-I**
Subject Code : **PCCV-522**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Quantify the specifications of various road construction materials required

CO2: Perform geometric design of highways and expressways

CO3: Perform analysis and design of flexible and rigid pavements

CO4: Address highway maintenance, drainage and economic issues

CO5: Perform the traffic studies necessary before making changes to or designing new road Infrastructure

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.4	2.2	2	2.8	2	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	General	Different modes of transport, Development of Transport System, Phased development of Roads in India, Planning & Management of Highways, Various road plans developed in India, Road patterns, Highway Surveys & Alignment, Design, Drawings, Estimates & Project Report	6
	Traffic Studies	Road user characteristics, Importance of traffic studies, spot speed, speed and delay and origin and destination studies. Traffic accident studies, Causes of accidents and Remedial Measures, Parking studies	7
	Geometric Design of Highways	Introduction, Highways Classification, Right of way, Width of formation, Sight Distances, Stopping site distance, overtaking sight distance, overtaking zones, camber, Road Curves, Transition Curves, Super elevation, Widening at curves, IRC codal	7

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		recommendations for various geometric design parameters, Road Safety Audits, Highway capacity & Intersection design	
	Construction of Roads	Various types of bituminous layers constructions and their selection, specifications for embankments, subgrade, granular subbase, water bound macadam, wet mix macadam, surface dressing, premix carpet, bituminous macadam, dense bituminous macadam, bituminous concrete, mastic asphalt, stone matrix asphalt, dry lean concrete, cement concrete pavements, Importance & Principles of Highway Drainage, Surface Drainage & Sub-Surface drainage	8
Unit-2	Types of bituminous binders and Mix design	Manufacturing of bitumen, Paving bitumen specifications as per IS 73: 2013, comparison between bitumen, tar, cut back & emulsion, Modified binders and its rheology, Design of bituminous mixes: Requirement of bitumen mixes, design of bituminous mixes as per Marshall Stability & flow method, parametric evaluation of bituminous mixes, IRC & MORTH recommendations for the design mix of various layers of pavements	8
	Pavement Design	Factors affecting design of pavements, design principles & design procedures as per IRC 37 guidelines, Design of PQC pavements as per IRC 58 & SP62, Use of software's IITPAVE, KENPAVE	6
	Failures of flexible and rigid pavements & Highway Maintenance	Causes of Failures and Remedial Measures, Maintenance of flexible and rigid pavements, pavement evaluation and	6

Total=48**Recommended Books:**

1. Sharma & Sharma; Principle and Practice of Highway Engineering, Asia Publishing House, New Delhi (2010).
2. G.V.Rao, Tata McGraw Hill, New Delhi Principles of Transportation and Highway Engineering (2002)
3. Yoder E. J.; Principles of Pavement Design, John Wiley & Sons (2011)

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Title of the course : **Design of Concrete Structures**
Subject Code : **PCCV-523**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: To impart fundamental knowledge of the behavior and properties of reinforced cement concrete as a structural material.
- CO2: To develop the ability to analyze and design various structural elements such as beams, slabs, columns, and footings as per relevant IS codes.
- CO3: To familiarize students with the limit state method of design, emphasizing safety, serviceability, and economy.
- CO4: To enable students to interpret and apply design standards, specifications, and detailing practices in RCC structures.
- CO5: To cultivate problem-solving skills and practical understanding for real-world civil engineering applications involving RCC construction.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	3	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	3	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.4	2.8	2.6	2.0	2.8	2.0	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Reinforced concrete, definition, properties of materials, grades of concrete and reinforcing steel, stress-strain curves, permissible stresses, design philosophies: working stress design, ultimate strength and limit state design method.	6
	Limit State Design Method	Introduction, Limit States, Characteristic values, characteristic strength, characteristic loads, design values for materials and loads, factored loads.	5
	Limit State of Collapse (Flexure)	Types of failures, assumptions for analysis and design of singly reinforced, doubly reinforced, and flanged sections.	7

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		Design of Lintels, Design of one-way slabs and two-way rectangular slabs.	
	Limit State of Collapse (Shear, bond and torsion)	Introduction - Design for shear, structural components subjected to torsion, design of rectangular beam section for torsion, development length, the continuation of reinforcement (beyond cut-off points).	6
	Limit State of Serviceability	Deflection, effective span to effective depth ratio, modification factors for singly reinforced, doubly reinforced and flanged beams, crack formation and its control	6
Unit-2	Limit State of Collapse (Compression)	Limit State of Collapse (Compression): Columns and their classification, reinforcement in columns, assumptions, short and long (both tied and helical) columns subjected to axial load, short columns subject to axial, uniaxial and biaxial bending, Interaction Diagrams	8
	Limit State Design of miscellaneous structures	Design of isolated footings, Design of staircases.	5
	Introduction to Working Stress Design Method	Application of SP 16 and Detailing of Reinforcement: Use of SP: 34, Codal Provision for RC Elements: (I) General (II) for ductility.	5

Total=48

Recommended Books:

1. Reinforced Concrete Design, Pillai & Menon, Tata McGraw Hill Publishers(2022).
2. Limit State Design of Reinforced Concrete, Varghese, P. C., Prentice Hall of India(2008).
3. Fundamentals of Reinforced Concrete, Sinha, S. N. and Roy, S Chand Publishers(2014)

Rahul Pan X JS W  \$e^{61}\$ Shukla Rajinder Singh 

Title of the course : **Hydrology and Ground Water**
Subject Code : **PCCV-524**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1:To understand the components of the hydrologic cycle and their relevance in water resource engineering.

CO2: To develop skills in measurement, estimation, and analysis of precipitation and abstractions such as evaporation and infiltration.

CO3: To learn methods of streamflow measurement and discharge computation using various hydraulic structures and instruments.

CO4: To analyze flood data using frequency analysis methods and understand flood routing techniques.

CO5: To study the principles of groundwater hydraulics including aquifer properties, Darcy's Law, and steady flow towards wells.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	2	3	1	2	2	2	1	3	2	3	3
CO2	3	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	2	2	1	3	2	1	2	3	2	2	2	3	3	3
Avg.	2.6	2.2	2.2	1.6	2.8	2.0	1.0	1.8	2.6	1.8	1.6	2.6	2.8	2.6	2.8

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Hydrologic cycle, Scope and Applications	4
	Precipitation	Measurement by rain gauge and other methods, estimation of missing data, consistency of records, optimum number of rain gauge station, mean precipitation, presentation and analysis of rainfall data	8
	Abstractions from Precipitation	Evaporation, factors affecting evaporation, measurement, infiltration, factors affecting infiltration, measurement, infiltration indices	8
	Stream flow measurement	Velocity measurement: floats, velocity rods, current meters, discharge computation: velocity area method, moving boat	10

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		method, slope area method, stage discharge curve, notches, weirs, venturiflume, standing wave flume, free overfall	
Unit-2	Floods Frequency analysis	Peak flood estimation, methods of frequency analysis, flood routing	10
	Ground Water Hydraulics	Type of aquifers, aquifer constants, Darcy's law, Steady flow towards fully penetrating well, Equation of motion and its applications to ground water flow problems, introduction to the use of distributed groundwater	8

Total=48

Recommended Books:

1. Chow, V.T., Maidment, D.R., and Mays, L.W., Applied Hydrology, Mc-Graw-Hill International Editions, New York (2006)
2. Misstear, B., Banks, D., and Clark, L., Water Wells and Boreholes, John Wiley & Sons Ltd, UK(2013)
3. Shaw, E.M., Beven, K.J., Chappell, N.A., and Lamb, R., Hydrology in Practice, Spon Press, New York(2014)
4. Viessman, W. and Lewis, G.L., Introduction to Hydrology, Prentice Hall of India Pvt Limited, New Delhi (2012)

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Title of the course : **Biology for Engineers**
Subject Code : **BSBL- 501**

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Outcomes:

On successful completion of the subject, the students will be able to

- CO1 Learn about correlation between biological science and engineering.
- CO2 Understand about the concept of microbiology, genetics, and macromolecules.
- CO3 Learn the techniques of microbiological enumerations, food spoilage and preservation.
- CO4 Familiarize with economic aspects of biological intervention.
- CO5 Familiarize with various aspects of metabolic pathways.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	2	3	3	1	3	3	3	3	1	3	1	2
CO2	3	3	1	3	3	3	3	3	3	3	3	2	2	2	2
CO3	1	3	3	2	3	3	3	3	3	3	3	1	3	2	3
CO4	1	3	2	1	3	1	3	3	3	3	3	3	3	2	2
CO5	3	3	3	3	3	3	3	3	3	1	3	3	2	2	2
Avg.	2	2.6	2.2	2.2	3	2.6	2.6	3	3	2.6	3	2	2.6	1.8	2.2

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Importance of biology in engineering, development of technological subjects imitating nature's biological entity, major discoveries in biology, economic aspects of biology in exploitation.	2
	Classification	Concept of scientific classification of living entity, discuss the classification (with suitable example) based on: (a) cellularity- unicellular and multicellular (b) ultrastructure- prokaryotes and eukaryotes (c) energy and carbon utilization- autotrophs, heterotrophs and lithotrophs (d) ammonia excretion- aminotelic, uricotelic and ureotelic (e) molecular taxonomy- three major kingdoms of life, classification of microorganisms based on: (a) temperature (b) salt concentration (c) oxygen requirement	4
	Genetics	Concept of genetics, Mendel's laws, segregation and independent assortment, allele, meiosis and mitosis, recessiveness and dominance, how genetic material passes from parent to offspring, difference between phenotypic and genotypic characteristics.	4

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		DNA fingerprinting, exploitation of genetics in crop improvement and microbial potential towards fermentation/ fermented product.	
	Microbiology	Microorganisms, classification of microorganisms, techniques such as serial dilution, pour plating, streak plating, spread plating, nutrient agar and broth. Techniques for enumeration of bacteria, growth kinetics, concept of food spoilage and preservation technique.	5
Unit-2	Biomolecules	Biomolecules as building blocks of biological subjects, introductory information about carbohydrates, proteins, nucleotides, and DNA/RNA, structure of protein (primary, secondary, tertiary, quaternary), structure of selected monosaccharides (glucose, fructose), disaccharides (sucrose, maltose) and polysaccharides (starch, cellulose).	4
	Enzymes	Enzyme, enzymology, role of enzymes in biological system, mechanism of enzymatic action, role of prosthetic group, co-factor and co-enzymes in enzymatic reactions, classification of enzymes, application of enzymes in: (a) juice clarification (b) meat tenderization (c) enzymatic browning.	4
	Metabolism	Concept of thermodynamics and application in biological system, photosynthesis, glycolysis, Krebs cycle, exothermic and endothermic reactions, endergonic and exergonic reactions.	5
			Total=28

Recommended Books:

1. Neil A. Campbell, Biology: A global approach
2. Eric E Conn, Outlines of biochemistry
3. Prescott, Microbiology
4. Gunther S. Stent, Molecular genetics

Title of the course : Numerical and Statistical Methods Lab
Subject Code : BSMA- 502

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

The course aims to shape the attitudes of learners regarding the field of statistics. Specifically, the course aims to motivate in students an intrinsic interest in statistical thinking and Instil the belief that statistics is important for scientific research.

Upon completion of this course, the student will be able to:

- CO1: Understand the concept of errors in numerical methods.
CO2: Find the roots of equations using different methods and discuss the convergence of the solution.
CO3: Understand the concept of different operators and their applications in solving numerical differentiation and integration.
CO4: Solve numerically ordinary differential equations of first order.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	3	2	3	3	2	2	3	1	2
CO2	3	3	3	3	2	2	3	2	3	3	2	2	3	2	2
CO3	3	3	3	3	2	2	3	2	3	3	2	2	3	1	3
CO4	3	3	3	3	2	2	3	2	3	3	2	2	3	1	2
Avg.	3	3	3	3	2	2	3	2	3	3	2	2	3	1.25	2.25

List of Programmes:

- Finding roots of the equation $f(x) = 0$ using
 - Bisection Method
 - Secant Method
 - Method of false position
- Finding roots of the equation $f(x) = 0$ using
 - Iterative Method
 - Newton - Raphson's Method
- To check consistency and finding Solution of a system of linear algebraic equations using
 - Gauss elimination Method
 - Gauss - Seidal Method
 - Jacobi Method
- Interpolation using
 - Newton's forward difference formula
 - Newton's backward difference formula
- Interpolation using
 - Newton's divided difference formula
 - Lagrange's interpolation formula
- Numerical differentiation using
 - Newton's forward interpolation formula
 - Newton's backward interpolation formula
- Numerical Integration using
 - Trapezoidal rule
 - Simpson's $1/3^{\text{rd}}$ rule
 - Simpson's $3/8^{\text{th}}$ rule
- Solution of 1^{st} order ordinary differential equations using

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- i) Taylor's series method
 - ii) Picard's method
 - iii) Euler's method
 - iv) Euler's modified method
9. Solution of 1st order ordinary differential equations using Runge-Kutta methods.
10. Fitting a curve using given data.
- i) linear curve
 - ii) quadratic curve
 - iii) cubic curve
 - iv) any other
11. Finding the following, using given data:
- i) mean, median and mode.
 - iii) standard deviation and mean deviation.
 - ii) moments, skewness and kurtosis of various order.
 - iv) rank correlation.

Rajendra Singh

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Shubh

Rajendra Singh

Title of the course : Solid Mechanics Lab
Subject Code : PCCV-525

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

- CO1: To understand the fundamental concepts of stress, strain, and their relationship under different loading conditions.
CO2: To analyze axial, shear, bending, and torsional loading on structural elements.
CO3: To study and apply the principles of elasticity and equilibrium in solving problems related to deformable bodies.
CO4: To determine bending stresses and shear stresses in beams and torsional stresses in shafts.
CO5: To evaluate slope and deflection in beams and understand the stability of columns under axial loads.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	3	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	1	3	3	2	3	3	3	3	3	3	3	1	3	2	3
CO4	1	3	2	1	3	1	3	3	3	3	3	3	3	2	2
CO5	3	3	3	3	3	3	3	3	3	1	3	3	2	2	2
Avg.	2.0	2.8	2.4	1.8	2.8	2.4	2.2	2.6	2.6	2.2	2.4	2.4	2.6	2.4	2.6

List of Experiments:

- To find out the tensile strength of ductile materials (MS/Al) and plot its stress-strain characteristics.
- To determine impact strength of ductile and brittle materials.
- Experimental verification of theory of bending (calculation of bending stress and deflections at various points in the beam theoretically and verifying the same experimentally) and indirect evaluation of the modulus of elasticity.
- To determine the hardness of different types of materials

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Title of the course : **Transportation Engineering-I Lab**
 Subject Code : **PCCV-526**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Understand the characterization of highway materials

CO2: Know the procedure for testing of properties of aggregate

CO3: Know the procedure for testing of bituminous materials

CO4: Know the standard specifications of IS/IRC/MORTH for judging suitability of these materials

CO5: Understand the knowledge for testing material in field

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	3	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	1	3	3	2	3	3	3	3	3	3	3	1	3	2	3
CO5	1	3	2	1	3	1	3	3	3	3	3	3	3	2	2
Avg.	1.8	2.6	2.2	1.6	2.8	2.0	1.8	2.4	2.6	2.2	2.0	2.4	2.8	2.4	2.6

List of Experiments:

1. Flakiness and Elongation Index of aggregates
2. Aggregate Impact Test
3. Los-Angeles Abrasion Test on Aggregate
4. Crushing Strength Test on Aggregate
5. Specific gravity and water absorption test on coarse aggregate
6. Penetration Test on Bitumen
7. Ductility Test on Bitumen
8. Viscosity Test on Bituminous Material
9. Softening Point Test on Bitumen
10. Flash and Fire Point Test on Bitumen

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Title of the course : **Structural Analysis**
Subject Code : **PCCV-611**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After completion of the course students will be able to:

- CO1: Analyze continuous beams and frames using various methods
- CO2: Understand and apply concepts of unsymmetrical bending
- CO3: Interpret and construct influence line diagrams for beams
- CO4: Analyze structural responses in rolling load conditions
- CO5: Analyze three-hinge, two-hinge and fixed arches

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2	3	1	2	2	2	1	3	2	3	3
CO2	3	3	3	3	3	2	1	2	2	2	2	2	3	3	3
CO3	3	3	3	3	3	1	1	2	3	1	1	3	3	2	2
CO4	3	3	3	3	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	2	3	1	2	2	2	1	3	2	3	3
Avg.	3	3	2.8	3	2.6	2.2	1	1.8	2.4	1.8	1.4	2.8	2.6	2.6	2.8

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Displacements	Energy Methods: Strain energy in members, Betti's and Maxwell's Laws of reciprocal deflections, Castigliano's theorems, Unit load method for 2D-frames.	8
	Indeterminate structures:	Introduction, Static and kinematic indeterminacies, Stability of structures, internal forces in two and three-dimensional structures.	12
Unit-2	Analysis of Indeterminate Beams and Frames	Classical Methods: Theorem of three moments Methods of consistent deformation, Introduction to development of flexibility matrix; Conventional methods: Slope deflection method, Moment Distribution method, Introduction to development of stiffness matrix.	14
	Moving Loads and Influence Line Diagrams for Statically Determinate Structures	Bending moment and shear force diagrams due to single and multiple concentrated rolling loads and uniformly distributed moving loads, equivalent UDL, shear force and bending moment envelopes.	14

Total=48

Rahul *Pdpr* *JS* *70* *Re* *Shubh* *Pajinder* *Pat*

Recommended Books:

1. Indeterminate structures, R.L. Jindal S. Chand & Co., N. Delhi. Advanced Structural Analysis- A.K. Jain, Nem Chand & Bros., Roorkee.
2. Structural Analysis-A Unified Approach, D.S. Prakash Rao, University Press, Hyderabad.
3. Structural Analysis-A unified classical & Matrix Approach, A. Ghali & A.M. Neville, Chapman & Hall London.
4. Theory of Structures, - Vol. I & II, - S.P. Gupta & G.S. Pandit, Tata McGraw Hill, N. Delhi.

Rakshya Raj 28 14 71 Shubh Rajinder Singh

Title of the course : Soil Mechanics

Subject Code : PCCV-612

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Quantify the specifications of various road construction materials required

CO2: Perform geometric design of highways and expressways

CO3: Perform analysis and design of flexible and rigid pavements

CO4: Address highway maintenance, drainage and economic issues

CO5: Perform the traffic studies necessary before making changes to or designing new road Infrastructure

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.4	2.2	2	2.8	2	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

Theory

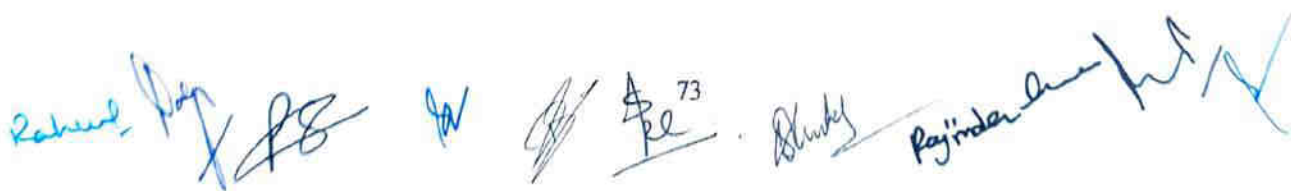
Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Soil formation, various soil types	4
	Phase relationships	Index properties, sieve & hydrometer analysis, Atterberg's limits, sensitivity, thixotropy, and plasticity charts. Determination of engineering properties of soil. Indian standard and Unified classification systems of soils	4
	Clay Mineralogy	Introduction to Clay minerals their characteristics. Soil structure	4
	Seepage and Permeability	Darcy's law, validity of Darcy's Law, seepage velocity, factors affecting permeability, Laboratory and field determination of permeability. Flow net and its properties, Laplace equation, methods of drawing flownet, seepage through earth dams, exit gradient and seepage pressures, phenomenon of piping and heaving, filters. Anisotropy, Permeability of layered soils	4

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Unit-2	Stresses in Soils	Stresses beneath various loaded areas, Boussinesq and Westergard's formulae, pressure bulbs, Newmark's chart, Approximate methods	6
	Consolidation	Terzaghi's theory, time rate of consolidation, consolidation test, Compressibility & Coefficient of Consolidation, NC, OC soils, determination of pre-consolidation pressure, settlement analysis, secondary consolidation	8
	Shear Strength	Definition, Mohr's stress circle, Mohr-Columb strength theory, direct, triaxial, unconfined and vane shear	6
	Effective Stress Principle	Capillarity, types of head, seepage forces, quick sand condition, and critical hydraulic gradient	6
	Compaction	Compaction tests as per IS code, OMC, factors affecting compaction, control of compaction, field compaction equipment and their suitability tests. Drainage conditions, Concept of pore pressure coefficients, shear characteristics of normally consolidated, over consolidated clays and dense and loose sands, Dilatancy, residual strength	6

Total=48**Recommended Books:**

1. Khanna S.K. and C.E.G. Justo, Highway Engineering, Nem Chand Bros (2017).
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee (2018).
3. Sharma & Sharma; Principle and Practice of Highway Engineering, Asia Publishing House, New Delhi (2010).
4. G.V. Rao, Tata McGraw Hill, New Delhi "Principles of Transportation and Highway Engineering" (1996)
5. Yoder E. J.; Principles of Pavement Design, John Wiley & Sons (2011)



Title of the course : **Building Material and Construction**
 Subject Code : **OECV-611 A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Identify different building components.

CO2: Understand concept of sustainable buildings and materials

CO3: Characterize different materials used in construction along with their applications

CO4: Develop knowledge about physical and chemical properties along with advantages and disadvantages of materials used in construction.

CO5: Understand basic knowledge about installation of doors and window

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	2
CO2	2	3	2	2	3	2	1	2	3	2	2	2	3	3	2
CO3	2	2	2	1	3	1	1	2	3	1	1	3	3	3	2
CO4	3	2	2	2	3	1	1	1	3	2	2	3	3	2	3
CO5	2	3	2	2	3	2	1	2	3	2	2	2	3	3	2
Avg.	2.2	2.4	2	1.8	2.8	1.8	1	1.8	2.8	1.8	1.6	2.6	2.8	2.8	2.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Cement	Cements composition, types of cement, manufacturing of ordinary Portland cement, testing of cement, special types of cement, storage of cement.	4
	Stones	Classification, requirements of good structural stone, quarrying, blasting and sorting out of stones, seasoning of stone, deterioration of stones, common building stones of India.	4
	Brick and Tiles	Classification of bricks, constituents of good brick earth, harmful ingredients, manufacturing of bricks, testing of bricks. Tiles, Terra-cotta, manufacturing of tiles and terra-cotta, types of terra-cotta, uses of terra-cotta, AAC blocks, hollow concrete blocks.	5
	Mortars	Definition, proportions of lime and cement mortars, Classifications & Properties.	4

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	Concrete	Introduction, properties of concrete, water cement ratio, workability, compressive strength, grades, Production of Concrete: Batching, mixing, transportation, placing, compaction and curing of concrete, quality control of concrete, concrete mix design.	7
	Special Concrete	Light weight concrete, high strength concrete, mass concrete, waste material-based concrete, shotcrete, fiber reinforced concrete.	4
Unit-2	Admixtures and Super-plasticizers	Functions, classification, accelerating admixture, water reducing admixture, retarding admixture, air-containing admixture	4
	Timber	Classification of timber, structure of timber, seasoning of timber, defects in timber, characteristics of good timber	4
	Metals	Manufacture of steel, market forms of steel e.g., mild steel and HYSD steel bars, rolled steel sections. Thermo-Mechanically Treated (TMT) Bars.	4
	Introduction to building construction	Basic building components (Foundation, plinth, wall, sill, lintel, roof, doors, windows, ventilators, staircases, sunshades etc.), Role of materials in construction, green building materials, fire resistance materials.	4
	Miscellaneous Materials	Asphalt, Bitumen, insulating materials, materials for doors and windows, paints, Introduction to refractories, laminate, adhesives, graphene and carbon composites.	4

Total=48**Recommended Books:**

1. Rangawala S.C. Engineering Materials Chortor Publishing House, Anand (1992).
2. Gambhir M. L., Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., New Delhi (2004).
3. Rangawala S. C., Engineering Materials, Charotar
4. S.K. Duggal Building Materials, New Age International Publications 2006.
5. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
6. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973

Title of the course : **Disaster Preparedness & Planning**
Subject Code : **OECV-611 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Identify various types of disasters, their causes, effects & mitigation measures.

CO2: Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.

CO3: Understand the use of emergency management system to tackle the problems.

CO4: Discuss the role of media, various agencies and organisations for effective disaster management.

CO5: Design early warning system and understand the utilization of advanced technologies in disaster management.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.4	2.2	2	2.8	2	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

Theory

Unit	Main Topic	Course outline	Lecture(s)
Unit-1	Introduction to Disaster Management	Define and describe disaster, hazard, vulnerability, risk-severity, frequency and details, capacity, impact, prevention, mitigation.	6
	Disasters	Identify and describe the types of natural and manmade disasters, hazard and vulnerability profile of India, mountain and coastal areas, Factors affecting vulnerability such as impact of development projects and environment modifications (including dams, land-use changes, urbanization etc.), Disaster impacts (environmental, physical, social, ecological, economic etc.); health, psycho-social issues; demographic aspects (gender, age, special needs), Lessons and experiences from important disasters with specific reference to civil engineering.	12

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	Disaster Mitigation and Preparedness	Disaster Management Cycle-its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; Preparedness for natural disasters in urban areas.	6
	Risk Assessment	Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems; Use of Remote Sensing Systems (RSS) and GIS in disaster Management, early warning systems.	6
Unit-2	Post disaster response	Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, waste management, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.	10
	Integration of public policy	Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.	8

Total=48

Recommended Books:

1. Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill, Publisher
2. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester 92
3. Singh B.K., 2008, Handbook of disaster management: Techniques & Guidelines, Rajat Publications.
4. Disaster Management, R.B. Singh (Ed), Rawat Publications
5. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction

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Title of the course : Sustainable Construction Methods
Subject Code : OECV-612 A

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Understand fundamentals of sustainability in construction
- CO2: Identify and evaluate sustainable construction materials and technologies
- CO3: Apply sustainable building construction techniques
- CO4: Explore sustainable bridge construction methods
- CO5: Evaluate and implement emerging construction technologies

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	2	2	2	2	2	1	1	3	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	2	2	2	2	3	3	3	3
CO4	3	2	2	2	3	1	1	2	2	1	1	2	3	2	2
CO5	3	2	2	2	3	2	2	1	2	2	2	2	3	2	2
Avg.	3	2	2.2	2.2	2.8	1.6	1.4	1.6	2.4	1.6	1.6	2.4	3	2.2	2.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Definitions-Variety types- Pillars of Sustainability – Circle of Sustainability - Need-systems and their sustainability - Green Buildings -Difference between Green and Sustainability – Climate Change, Global warming -National and International policies and Regulations. Identification of cutting-edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.	10
	Building Construction Methods	Conventional modular construction methods, development, Engineering principles, benefits, Modular construction methods for repetitive works, Green Roofs, Cool Roofs, Passive House, Rammed Earth Brick, Passive Solar, Grey water Plumbing Systems, Solar Thermal Cladding, Solar Power, Water Efficiency Technologies, Sustainable Indoor Environment Technologies.	8

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	Precast Construction Methods	Modular construction methods for repetitive works; Precast concrete construction methods; Benefits , Sustainability in Concrete Mix Design, Greener, Faster and Sustainable Construction Practices Through Precast Solutions, Use of secondary cementitious material (SCM's) like GGBS, fly ash, ultra-fine GGBS in the production of the concrete, Basics of Slip forming for tall structures, Structural 3D Printing, Self-healing Concrete, Green Insulation, Sustainable Resource Sourcing, Environmental Sustainability Benefits From Precast Concrete.	10
Unit-2	Construction Methods Of Bridges	Types of foundations and construction methods; Basics of Formwork and Staging; Proactive Maintenance, Prefabrication/Modular Construction, balance between environment and construction activities, reducing problem sat site with minimal staging, increasing safety etc, Constructions are sustainable with reduced use of natural resources, Costs of Construction/Assembly and Transportation, Lifespan, Environmental Impact, harmful emissions during bridge construction, Reducing waste, solar panels to power LED lights to illuminate its deck, water-powered light system powered by the currents of the river, development that meets the needs of the present.	12
	New Construction Materials Technologies	Introduction to new construction materials & technologies, Synthetic Roof Underlayment, Electro chromic Glass, Biodegradable Materials, Reduction of water consumption, Impact on environment, Concepts of climate responsive building, Sustainability assessment using standard approaches- LEED/GRIHA rating evaluation process	8

Total=48

Recommended Books:

1. Margaret Robertson, Sustainability Principles and Practice, Routledge, 2014; Routledge; 3rd edition (10 February 2021)
2. Martin A. A. Abraham, Sustainability Science and Engineering: Defining Principles, Elsevier Science, 2005
3. Tony Clayton, Nicholas J. Radcliffe, Anthony M. H. Clayton, Sustainability: A Systems Approach, Routledge, 1996
4. Stephen M. Stephen, Stephen M. Wheeler, Climate Change and Social Ecology: A New Perspective on the Climate Challenge, Routledge, 2012
5. Gursharan Singh Kainth, Climate Change, Sustainable Development and India, LAP Lambert Academic Publishing, 2011

Title of the course : Road Safety
Subject Code : OECV- 612 B

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Identify factors contributing to road accidents

CO2: Apply road safety measures and data analysis techniques

CO3: Conduct road safety audits

CO4: Develop strategies for traffic safety during road operations

CO5: Design and implement traffic safety features

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	3	3	2	1	2	3	2	1	3	3	2	2
CO2	3	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	2
CO4	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO5	3	3	3	3	2	3	2	2	3	2	3	3	3	2	2
Avg.	2.6	2.6	2.4	2.6	2.8	2	1.4	1.8	3	1.8	1.8	3	3	2.2	2.2

Theory

Unit	Main Topic	Course out line	Lecture(s)
Unit-1	Road Accidents	Causes of road accidents: Vehicle design factors & Driver characteristic s influencing road safety, Road condition, Parking and its influence on traffic safety.	12
	Road safety measures:	Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to Identify and Prioritize Blackspots; Road safety measures.	12
Unit-2	Road safety audits	Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in Road safety	10
	Ensuring Traffic Safety in Road Operation: -	Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.	14

Total=48

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Recommended Books

1. BABKOV, V.F. 'Road conditions and Traffic Safety', MIR, publications, Moscow - 1975.
2. K.W. Ogden, 'Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
3. Kadiyali, L.R., 'Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
4. C. JotinKishty & B. Kent Lall, "Transportation Engineering-An Introduction", Third Edition, Prentice Hall of India Private Limited, New Delhi, 200

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Title of the course : **Advanced Surveying**
Subject Code : **PECV-611 A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

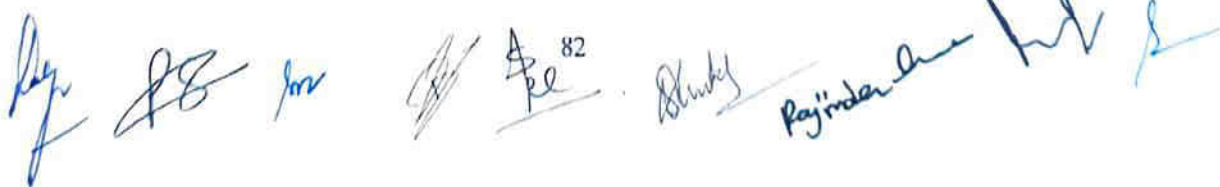
- CO1:** To understand the working principles, types, and applications of GPS and DGPS, along with sources of GPS errors in real-time and post-processing.
- CO2:** To gain knowledge about the fundamentals of remote sensing, electromagnetic spectrum, types of sensors, satellite orbits, and image interpretation techniques.
- CO3:** To learn the basic concepts and components of Geographic Information Systems (GIS), including data models, topology, projections, and Digital Elevation Models (DEMs).
- CO4:** To study the principles and applications of aerial surveying and photogrammetry, including stereoscopy and LIDAR technology for mapping and analysis.
- CO5:** To understand the use of drone technology in surveying, its accuracy, error control techniques, and its comparative advantages in modern geospatial applications.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	3	2	2	3	2	3	3	3	2	3
CO2	3	3	3	3	3	2	2	2	3	2	3	3	3	1	2
CO3	3	3	3	3	3	1	1	2	2	2	3	3	3	1	2
CO4	3	3	3	3	3	2	2	2	3	2	3	3	3	1	2
CO5	3	3	3	3	2	2	2	2	2	2	3	3	3	1	2
Avg.	3	3	3	3	2.6	2	1.8	2	2.6	2	3	3	3	1.2	2.2

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Global Positioning Systems (GPS):	Working Principle, Types of GPS, Application of GPS, DGPS-working Principle, DGPS errors (RT & PP).	10
	Fundamentals of Remote Sensing:	Introduction to Remote sensing and electromagnetic spectrum, types of sensors, Orbit and path, Geometric and Radiometric errors, image interpretation-visual and digital	10
	GIS techniques	Basic concepts, Topology, Data models- Vector and Raster, attribute, Digital Elevation models, Map, Projections	10
Unit-2	Aerial Surveying and Photogrammetry	Basic concepts, principles, and applications of photogrammetry, concepts, and applications for map preparation, Stereoscopy, LIDAR	10

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	Drone Surveying:	Introduction to drones, comparison of surveying drone and its accuracy; techniques of controlling errors	8
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Total=48

Recommended Books:

1. Gopi, S., Sathikumar, R, and Madhu, N. Advanced Surveying, Pearson Publisher, 2023
2. Garg, P.K., Introduction to surveying and geomatics engineering, CBS Publishing, 2023
3. Arora KR, Surveying (Vol. III). Standard Book House, 2015

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Title of the course : **Rock Mechanics**
Subject Code : **PECV-611 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Understand rock mechanics and classification of rocks

CO2:Conduct laboratory tests on rock samples

CO3: Perform in-situ testing on rocks

CO4: Evaluate stress in rock formations in field conditions

CO5: Apply rock stabilization techniques and tunnel design principles

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	3	3	3	3	3	2	1	2	2	1	1	2	3	2	2
CO5	3	3	2	3	2	2	2	1	3	2	3	3	3	2	2
Avg.	2.8	2.6	2.4	2.6	2.8	1.8	1.4	1.6	2.8	1.6	1.8	2.8	3	2.2	2.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Importance of rock mechanics, composition of rocks, geological and lithological classification of rocks, classification of rocks for engineering purposes, R.Q.D. method of classification of rocks. Theories of Brittle failure.	6
	Laboratory Testing of Rocks	Various methods of obtaining rock cores, methods of sample preparation, and methods of removing end friction of the rock samples. Compression testing machine, uniaxial compression strength of rock samples, methods of finding tensile strength-direct and indirect methods, Brazilian test, shear box test, triaxial shear test, punch shear test.	6
	In-situ Testing of Rocks	Field direct shear test on rock blocks, field triaxial strength, use of flat jacks, chamber test, plate load test, cable jacking test.	6

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	Stress Evaluation in Field	Stress-relief technique (over coring), use of strain gauges, bore hole, deformation cell, photo-elastic stress meter, stress measurement with flat jack. Hydraulics Fracturing Techniques.	6
Unit-2	Stabilization of Rocks	Rock bolting, principle of rock bolting, various types of rock bolts, application of rock bolting. Field testing of rock bolts and cable anchors.	6
	Elastic and Dynamic Properties of Rocks	Stress-strain behaviour dynamic properties, resonance method and ultra-sonic pulse method.	6
	Pressure on Roof of Tunnels	Trap door experiment, Terzaghi's theory, Bieramer, kommerel, Protodyakanov theory.	6
	Stress Around the Tunnels	Basic design and Principles of tunnels in rocks, design of pressure tunnels in rocks.	6

Total=48

Recommended Books:

1. Lama, et.al Rock Mechanics, Vol. I, II, III, IV
2. Jaeger and Cook, Fundamentals of Rock Mechanics, Blackwell Publishing
3. Stagg & Zienkiewicz, Rock Mechanics, Wiley-Blackwell
4. Obert & Duvell, Rock Mechanics & Design of Structures in Rocks, Wiley
5. Jaeger, Rock Mechanics & Engineering, Cambridge University Press
6. Károly Széchy, Art of Tunneling; Akadémiai Kiadó; 2d English ed. (rev. and enl.) edition (1 Jan. 1973)

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Title of the course : Soil Mechanics Lab
Subject Code : PCCV-614

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

- CO1: Determine basic physical properties of soil such as water content, specific gravity, particle size distribution, and Atterberg limits.
CO2: Conduct compaction and permeability tests to evaluate soil compaction characteristics and coefficient of permeability.
CO3: Perform shear strength tests including direct shear, unconfined compression, and vane shear to determine strength parameters of soil.
CO4: Analyze consolidation behavior of soils using consolidation-testing apparatus.
CO5: Interpret test results and relate them to field conditions for practical applications in geotechnical engineering.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	1	1	2	3	1	1	3	3	1	2
CO2	3	3	2	2	3	2	1	1	3	2	2	2	3	1	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	1	3
CO4	3	3	3	3	2	2	1	1	3	2	2	3	3	1	2
CO5	3	3	2	2	2	2	1	1	2	2	2	3	3	1	2
Avg.	3	3	2.6	2.4	2.6	1.8	1.2	1.4	2.8	1.8	1.8	2.8	3	1	2.4

List of Experiments:

1. Determination of field density by Core cutter & Sand replacement method
2. Grain size Analysis by Mechanical method
3. Grain Size Analysis by Hydrometer method
4. Determination of Specific Gravity by Pycnometer
5. Determination of Liquid Limit, Plastic limit
6. Determination of Shrinkage limit
7. Determination of Permeability by constant head & variable head permeameter
8. Determination of Coefficient of Consolidation by Consolidation Test
9. Determination of OMC and MDD by IS standard Compaction test
10. Direct Shear Test

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Title of the course : **Engineering Economics and Entrepreneurship**
Subject Code : **HSMC-603**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Understand the identify the type of interest simple, compound, present worth comparison equivalent, annual worth comparison with interest tables

CO2: Knowledge of obtaining annual payment monthly payment cash flow diagram depreciation.

CO3: Able to acquire skills regarding direct costs components of costs financial statement profit and loss account

CO4: Analyse the stability of profit planning balance sheet scope of finance functions.

CO5: Understand shrinking fund application concepts using formulas compound interest tables.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	2	2	1	1	1	1	1	2	2	2	1	2	2
CO2	1	1	1	1	1	2	2	2	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	2	2	1	1	3	1	2	2
CO4	1	1	1	1	1	2	2	2	1	1	1	2	1	1	1
CO5	1	1	1	1	1	1	1	2	2	1	1	3	1	2	2
Avg.	1	1	1.2	1.2	1	1.4	1.4	1.8	1.4	1.2	1.2	2.4	1	1.6	1.6

Theory

Unit	Main Topic	Course outline	Lecture(s)
Unit-1	Introduction	Engineers and Economics, Utility of its study, Managerial Economics, Nature and scope, basic terms and concept of economics like goods, kinds of goods.	02
	Theory of Demand and Supply	Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, The meaning of Supply, Supply function, Law of supply-Explanation of law of supply.	08
	Environment Analysis	Concept of National income- GDP, GNP, Monetary policy, Fiscal Policy.	05
	Entrepreneurship -Enterprise	Conceptual issues, Entrepreneurship vs. Management, Concept of Social Entrepreneurship and Women Entrepreneurship, Roles and functions of engineer in relation to the enterprise and in relation to the economy.	05

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	Business Excellence	Role of creativity and innovation and business research, Sources of business idea, TQM, Six Sigma	02
Unit-2	The process of setting up a small business	Preliminary screening and aspects of the detailed study of the feasibility of the business idea, Preparation of Project Report and Report on Experiential Learning of successful and unsuccessful entrepreneurs.	04
	Communication skills	Introduction, process of communication, barriers to communication, Removal of barriers, channels of communication, Verbal and non-verbal communication.	03
	Issues in small business marketing	The concept and application of product life cycle, Advertising and publicity, sales and distribution management, National, state level and grass-root level financial and non-financial institutions in support of small business development, MSME Act	07
	Human Resource Management	Introduction, definition, types, tools of motivation, Theories of motivation- Alderfer's ERG theory, Herzberg's theory of motivation, Mc Clelland theory. Introduction, objectives, scope, functions. Factory Act 1948	06

Total=42

Recommended Books:

1. Dutta A.K., Materials Management: Procedures, Text and cases, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Gopalakrishnan, P. and Sundareson, M., Materials Management: An Integrated Approach, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Varma, M.M., Essentials of Storekeeping and Purchasing, Sultan Chand and Sons, New Delhi.
4. Shah N.M. An Integrated concept of Materials Management, Indian Institute of Materials Management, Baroda Branch, Baroda.
5. Sharma S.C., Material Management and Materials Handling, Khanna Publishers, New Delhi.
6. Arnold, Champman and Ramakrishnan, Introduction to Materials Management 5th ed., 2007 Pearson Education, Inc.
7. Pooler Victor H. Purchasing and Supply Management, Creating the Vision, New York, Chapman & Hall, 1997.
8. Moore, J.M., Plant layout and Design, Macmillan New York.

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Title of the course : **Water and Waste Water Engineering**
Subject Code : **PCCV-621**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Understand the fundamentals of water supply systems
- CO2: Evaluate water quality standards and impurities
- CO3: Analyze water treatment processes
- CO4: Design and assess water conveyance systems
- CO5: Calculate storage and requirements for distribution reservoirs

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	2	2	2	2	2	3	3	2	3	2
CO2	3	3	2	2	1	1	2	1	1	1	2	2	3	1	1
CO3	2	3	3	3	2	1	2	1	2	2	3	3	3	2	2
CO4	3	3	2	3	2	2	2	1	2	2	3	3	3	3	2
CO5	3	3	3	2	2	2	2	1	2	2	3	3	3	3	2
Avg.	2.8	2.8	2.4	2.4	1.8	1.6	2	1.2	1.8	1.8	2.8	2.8	2.8	2.4	1.8

Theory

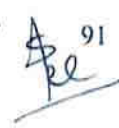
Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Water and water supply system	: Water quality, source of surface water pollution, water quality standards; Water demand, components of water supply system; water intake works; Water transmission systems	12
	Water treatment:	Water treatment plants and components; Technologies for the removal of suspended, colloidal and dissolved solids and for disinfection; Design of coagulation- flocculation-settling, slow sand and rapid gravity filtration, membrane filtration, ion exchange, adsorption and chlorination units.	12
Unit-2	Wastewater system	: Quantification of sewage; Characterization of sewage; Types of sewerage systems; Design of sewers and storm sewers, sewer outfalls and sewer appurtenances	12
	Wastewater treatment:	Components; Design of screens, degritters, clarifiers and roughing filters; Activated Sludge, UASB and modified UASB reactors, and Waste stabilization pond systems, vegetated ponds and constructed wetland systems; Sewage treatment plant sludge handling facilities	12

Total=48

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Recommended Books:

1. Water Supply and Sewerage: E.W. Steel.; McGraw-Hill, New York
2. Water Supply Engineering: S.R. Kshirsagar.; Roorkee Publication
3. Water Supply Engineering: S.K. Garg.; Khanna Publishers
4. Water Supply Engineering: B.C. Punmia., Laxmi Publications
5. Environmental Engineering: Peavy H. S., Rowe D. R. and Tchobanoglous G.; McGraw-Hill, New York
6. Introduction to Environmental Engineering: Davis M. L. and Cornwell D. A.
7. Water Supply and Sanitary Engineering: Birdie, G. S. and Birdie; Dhanpat Rai Publishing Company
8. Manual on Water Supply and Treatment: Ministry of Urban Dev., New Delhi.

Rahul, Pappu, SS, SN,  91,  Study, Rajinder,  

Title of the course : **Design of Steel Structures**
Subject Code : **PCCV-622**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1:** Understand the types of loads, structural steel materials and specifications, and apply IS:800 and IS:2062 standards in the design of structural elements considering strength, stiffness, and serviceability.
- CO2:** Analyze and design bolted and welded connections, including concentric and eccentric joints, and evaluate their efficiency and failure modes.
- CO3:** Design various types of tension members including angles, tees, tension splices, and lug angles, using appropriate net effective area concepts.
- CO4:** Analyze and design axially loaded compression members such as single and built-up columns, and understand concepts like slenderness ratio, effective length, and allowable stress.
- CO5:** Apply the fundamentals of plastic design including plastic hinges, collapse mechanisms, and determine collapse loads using static and mechanism methods.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	2	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	3	3	3	2	3	1	1	2	2	1	1	2	3	2	2
CO5	3	3	2	2	3	2	1	1	3	2	2	3	3	2	3
Avg.	3	2.8	2.4	2.2	3	1.6	1.2	1.6	2.8	1.6	1.6	2.6	3	2.2	2.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Loads, structural steels and their specifications, structural elements, design specifications as per IS: 800, structural layout, strength and stiffness considerations, efficiency of cross-section, safety and serviceability considerations as per IS2062-2011	12
	Bolted and Welded Connection	Types of Bolts, advantages and disadvantages of bolted connections, failure of bolted joints, design of the concentric bolted joint, the efficiency of joint. Design of Eccentric bolted connections. Welded Connection: Types of welded joints, design of welded joint subjected to axial loads	12
	Tension Members	Types of tension members, net area, net effective area for angles, tees, design of tension members, tension splice, and lug angles.	10

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Unit-2	Compression Members	Axially loaded columns, effective length, slenderness ratio, allowable stresses, general specifications, design of axially loaded members, laced and battened columns and their design, built-up compression members	10
	Plastic Design	Introduction, advantages and disadvantages, theory of plastic bending, plastic hinge mechanism, collapse load analysis, static and mechanism method, distributed loading, design consideration.	10
	Flexural Members (Beams)	Design criteria, permissible stresses, laterally supported beams and their design laterally unsupported beams and their design, web buckling, web crippling	10

Total=64**Recommended Books:**

1. Subramanya, N, Design of Steel Structures, N. Subramanian, Oxford University Press (2016).
2. Duggal, S.K. Limit State Design of Steel Structures, McGraw Hill (2010.)
3. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017
4. Sai Ram, K.S, Design of Steel Structures, Pearson Education in South Asia, 2010.
5. Chandra R. and Gehlot V, Limit State Design of Steel Structures, Scientific Publishers, 2009

Rahul, Raj, JS, W, ~~JS~~, ~~JS~~⁹³, Shubh, Rajinder, ~~JS~~, ~~JS~~

Title of the course : **Solid and Hazardous Waste Managements**
Subject Code : **OECV-621 A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Understand integrated solid waste management principles
- CO2: Analyze collection, storage and transportation systems for waste management
- CO3: Evaluate solid waste processing and treatment technologies
- CO4: Apply treatment and disposal methods for hazardous wastes
- CO5: Understand and comply with legal requirements for waste management

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	3	3	2	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	2	3	2	2	3	2	1	2	2	1	1	2	2	2	2
CO5	2	2	2	3	3	2	1	1	3	2	2	3	3	2	2
Avg.	2.4	2.6	2.4	2.6	2.8	1.8	1.2	1.6	2.8	1.6	1.6	2.6	2.8	2.2	2.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Definition of solid wastes and hazardous wastes, Nuisance potential and extent of solid waste problems, Objectives and scope of integrated solid waste management.	8
	Collection, Storage and Transportation of Wastes	Types of collection systems and their components, Concept of waste segregation at source and recycling and reuse of wastes.	8
	Solid Waste Processing and Treatment	Waste processing – processing technologies – biological and chemical conversion technologies–Composting-thermal conversion technologies-energy recovery.	8
Unit-2	Hazardous Waste Treatment and Disposal	Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes; Land farming; Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.	8

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Sanitary Landfills	Design, development, operation and closure of landfills, Management of leachate and landfill gases, environmental monitoring of landfill sites.	8
Legal Requirements	Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, fly ash, etc.	8

Total=48

Recommended Books:

1. Pichtel, J., Waste Management Practices–Municipal, Hazardous and Industrial, CRC Press
2. Vesilind, P.A., Solid Waste Engineering, Thomson Learning Inc.
3. Tchobanoglous, G., Vigil, S.A. and Theisen, H., Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill
4. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Eng.", McGraw Hill
5. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India

Rahul, P. S. 95, P. S. 95, P. S. 95, P. S. 95, P. S. 95, P. S. 95

Title of the course : Construction Equipment & Automation
Subject Code : OECV-621 B

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Understand Equipment's & Automation and key features of its performance
- CO2: Develop skills in equipment planning and selection
- CO3: Comprehend earthwork and concrete equipment operations
- CO4: Apply knowledge of specialized construction equipment's
- CO5: Explore automation and robotics in construction

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	3	1	2	2	3	1	1	3	3	2	2
CO2	2	2	2	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	2	3	2	2	2	3	2	2	3	3	3	3
CO4	2	2	3	3	3	1	1	2	2	1	1	2	3	2	2
CO5	3	2	2	2	3	2	1	2	3	2	1	3	3	3	3
Avg.	2.4	2.2	2.4	2.2	3	1.6	1.4	1.8	2.8	1.6	1.4	2.6	3	2.4	2.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Construction Equipment	Introduction, significance of equipment in construction industry - laboratory setting including plan reading, specification reading, construction scheduling and estimating, Job layout and its importance. Study of equipment with reference to available types and their types and their capacities, factors affecting their performance.	8
	Construction Equipment Management	Equipment Management- Introduction, Differences between men and manpower, Extent of Mechanization, Equipment planning, Selection of equipment, Forward planning, Purchase of Equipment, Specifications for ordering equipment.	8
	Equipment for Earthwork	Fundamentals of Earth Work Operations - Earth Moving Operations - Types-Excavation equipment- Power Shovels, Back Hoe, Drag line, Clamshell - Scrapers, Bull Dozers, Tractors, Hauling Equipment - Dump trucks, Dumpers Loaders, trucks, Earth Compaction Equipment-Tamping Rollers, Smooth Wheel	8

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		Rollers, Sheep foot Roller, Pneumatic-tired Roller, Vibrating Compactors, Vibro compaction methods.	
Unit-2	Other Construction Equipment	Pile driving Equipment - Erection Equipment – Cranes, Derrick Cranes, Mobile cranes, Overhead cranes, Traveler cranes, Tower cranes - Types of pumps used in Construction - Grouting - Material Handling Conveyors –Industrial Trucks, Forklifts and related equipment.	6
	Equipment for Concrete and Road laying	Aggregate production equipment- Different Crushers – Feeders - Screening Equipment -Handling Equipment - Batching and Aggregate Mixing Equipment - Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment – Ready mix concrete equipment, Concrete mixers, Concrete batching and mixing plant, Transportation of concrete mix, Concrete pouring and pumps, concrete compaction equipment	6
	Automation	Introduction & Technical terms of Automation and robotics; advantages & disadvantages, Need for construction automation, Applications, Automation in precast construction industry, Autonomous Machines on the Construction Site, Drones to Survey Working Areas , Robotics in Concrete Works, IoT Sensors to Collect and Process Data, Virtual Reality During Project Planning and Training , Automatic Concrete Screeding Machine, Concrete Surface Finishing Robot, Automation in High Rise Building Construction, Automation in prefabrication of masonry and on site masonry construction, partially automated masonry element prefabrication, automated manufacture of brick wall masonry blocks, Automation in timber construction, Automation in production of steel components, Transformable welding robot.	12

Total=48

Recommended Books:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.
2. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988.
3. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.
4. Dr. Mahesh Varma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 1983.

Title of the course : **Repairs & Rehabilitation of structure**
Subject Code : **OECV-622 A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Understand the need for structural rehabilitation
- CO2: Analyze causes and defects of deterioration in concrete structures
- CO3: Evaluate strength and durability factors in concrete
- CO4: Implement surface repair and retrofitting methods
- CO5: Apply strengthening and seismic rehabilitation techniques

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	3	3	3	2	1	1	3	2	2	2	3	2	2
CO3	3	3	3	2	2	2	2	2	2	2	2	3	3	2	3
CO4	3	3	2	3	3	1	1	2	2	1	1	2	3	2	2
CO5	3	3	3	3	3	3	2	1	3	2	3	3	3	2	2
Avg.	3	2.8	2.6	2.6	2.8	1.8	1.4	1.6	2.6	1.6	1.8	2.6	3	2	2.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction to Rehabilitation of Structures	Aging of Structures, Performance of Structures, need for rehabilitation of structural members, Maintenance, Facets of Maintenance, Importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration.	7
	Evaluation and Deterioration of Concrete Buildings	Visual Integration, Destructive Testing Systems, Non Destructive Testing Techniques, Semi Destructive Testing Techniques, Chemical Testing, Embedded Metal Corrosion, Disintegration Mechanisms, Moisture Effects, Thermal effects, Structural effects, Faulty construction, Distress in structure due to corrosion, fire, leakage, earthquake and effects, case studies, damage assessment and evaluation models.	9
	Strength and Durability of Concrete	Quality assurance for concrete – Strength, Durability and Thermal properties of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness and	12

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		cracking, Methods of corrosion protection, Corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection, Special concretes -- Polymer concrete, Sulphur infiltrated concrete, Fiber reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geo-polymer concrete, Reactive powder concrete, Concrete made with industrial wastes.	
Unit-2	Surface Repair and Retrofitting	Strategy and Design, Selection of Repair Materials, Surface Preparation, Bonding Repair Materials to existing concrete, Placement methods, Epoxy bonded replacement concrete, Preplaced aggregate concrete, Shotcrete/Gunite, Grouting, Injection Grouting, Micro concrete, Mortar repair for cracks, shoring and underpinning.	10
	Strengthening Techniques and Seismic Rehabilitation	Beam Shear Capacity Strengthening, Shear Transfer Strengthening between members, Column Strengthening, Flexural Strengthening and Crack Stabilization, Seismic strengthening of structures, Guidelines for Seismic Rehabilitation, Seismic Vulnerability and Strategies for Seismic Retrofit.	10

Total=48

Recommended Books:

1. R.T. Allen and SC Edwards, "Repair of Concrete Structures", Blakie and Sons, 1987
2. FEMA273, NEHRP Guidelines for Seismic Rehabilitation of Buildings, 1997
3. Dov Kominetzky. M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001
4. Emmons, P.H., "Concrete Repair and Maintenance", Galgotia Publication, 2001
5. Ravishankar. K, Krishnamoorthy. T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.
6. Malhotra, V.M. and Carino, N.J., "Handbook on Non Destructive Testing of Concrete", CRC press, 2004
7. Bohni, H., "Corrosion in Concrete Structures", CRC Press., 2005
8. Shetty M.S., "Concrete Technology – Theory and Practice", S. Chand and Company, 2008.
9. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
10. P.C. Varghese, "Maintenance Repair and Rehabilitation and Minor Works of Bridges", PHI learning Pvt. Ltd, 2014.

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Title of the course : **Ground Improvement Technique**
 Subject Code : **OECV – 622 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Learn about geo-synthetics and their properties
- CO2: Design the foundations on stabilized soils
- CO3: Compare the results with non-stabilized soils
- CO4: Study the Soil improvement using reinforcing elements
- CO5: Learn about Geotextiles

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	2	2	3	2	2	1	2	2	2	2	3	2	3
CO3	3	3	3	3	2	2	2	2	3	2	2	3	3	3	3
CO4	2	3	2	2	3	1	1	2	2	2	2	2	3	2	2
CO5	3	3	2	2	3	2	1	1	3	2	2	3	3	2	3
Avg.	2.8	2.8	2.2	2.2	2.8	1.6	1.4	1.6	2.6	1.8	1.8	2.6	3.0	2.2	2.6

Theory:

Unit	Main Topics	Course Outline	Lecture(s)
Unit-1	Introduction	Role of ground improvement in foundation engineering– Geotechnical problems in alluvial, lateritic and black cotton soils, Methods of ground improvement Selection of suitable ground improvement techniques based on soil conditions.	8
	In situ densification of cohesion	Less soils and consolidation of cohesive soils: Dynamic compaction Vibro flotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns and Lime piles- installation techniques – simple design – relative merits of above methods and their limitations	10

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Unit-2	Soil improvement with the addition of materials	lime stabilization - lime column method - stabilization of soft clay or silt with lime – bearing capacity of lime treated soils – settlement of lime treated soils - improvement in slope stability -control methods - chemical grouting – commonly used chemicals - grouting systems – grouting operations - applications - compaction grouting - introduction - application and limitations – plant for preparing grouting materials - jet grouting – jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone column	12
	Soil improvement using reinforcing elements	Introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors -reinforced earth retaining walls.	10
	Geotextiles	Behaviour of soils on reinforcing with geo textiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls – pavements	8

Total=48

Recommended Books:

1. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall
2. Boweven R., Text Book on Grouting in Engineering Practice, Applied Science Publishers Ltd
3. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
4. Van Impe W.E., Text Book On Soil Improvement Technique & Their Evolution, Balkema Publishers
5. Donald. H. Gray & Robbin B. Sotir, Text Book On Bio Technical & Soil Engineering Slope Stabilization, John Wiley
6. Rao G.V. & Rao G.V.S., Text Book On Engineering with Geotextiles, Tata McGraw Hill
7. Korener, Construction & Geotechnical Methods in Foundation Engineering, McGraw Hill
8. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
9. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication

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Rehmat,  ~~~~ $\102  Rajinder 

Total = 48

1. Arora and Saxena, Railway Engineering, Dhanpat Rai & Sons, New Delhi (2006).
2. Khanna, Arora & Jain, Airport Planning and Design, Nem Chand & Brothers, Roorkee (1999).
3. ICAO and FAA, various advisory circulars guidelines (2018).
4. Rangawala, Railway Engineering, Charotar Publishing House, Anan (1989).
5. Aggarwal M.M., and Satish Chandra Railway Engineering, Oxford University Press (2013).
6. Horenjeff Robert, Airport Engineering, McGraw Hill International Publisher (2010).

Title of the course : Ground Improvement Technique
Subject Code : PECV – 621 B

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Learn about geo-synthetics and their properties
- CO2: Design the foundations on stabilized soils
- CO3: Compare the results with non-stabilized soils
- CO4: Study the Soil improvement using reinforcing elements
- CO5: Learn about Geotextiles

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	2	2	3	2	2	1	2	2	2	2	3	2	3
CO3	3	3	3	3	2	2	2	2	3	2	2	3	3	3	3
CO4	2	3	2	2	3	1	1	2	2	2	2	2	3	2	2
CO5	3	3	2	2	3	2	1	1	3	2	2	3	3	2	3
Avg.	2.8	2.8	2.2	2.2	2.8	1.6	1.4	1.6	2.6	1.8	1.8	2.6	3.0	2.2	2.6

Theory:

Unit	Main Topics	Course Outline	Lecture(s)
Unit-1	Introduction	Role of ground improvement in foundation engineering– Geotechnical problems in alluvial, lateritic and black cotton soils, Methods of ground improvement Selection of suitable ground improvement techniques based on soil conditions.	8
	In situ densification of cohesion	Less soils and consolidation of cohesive soils: Dynamic compaction Vibro flotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns and Lime piles- installation techniques – simple design – relative merits of above methods and their limitations	10

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Unit-2	Soil improvement with the addition of materials	lime stabilization - lime column method - stabilization of soft clay or silt with lime - bearing capacity of lime treated soils - settlement of lime treated soils - improvement in slope stability - control methods - chemical grouting - commonly used chemicals - grouting systems - grouting operations - applications - compaction grouting - introduction - application and limitations - plant for preparing grouting materials - jet grouting - jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone column	12
	Soil improvement using reinforcing elements	Introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors - reinforced earth retaining walls.	10
	Geotextiles	Behaviour of soils on reinforcing with geo textiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls - pavements	8

Total=48**Recommended Books:**

1. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall
2. Boweaven R., Text Book on Grouting in Engineering Practice, Applied Science Publishers Ltd
3. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
4. Van Impe W.E., Text Book On Soil Improvement Technique & Their Evolution, Balkema Publishers
5. Donald. H. Gray & Robbin B. Sotir, Text Book On Bio Technical & Soil Engineering Slope Stabilization, John Wiley
6. Rao G.V. & Rao G.V.S., Text Book On Engineering with Geotextiles, Tata McGraw Hill
7. Korener, Construction & Geotechnical Methods in Foundation Engineering, McGraw Hill
8. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
9. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication

Title of the course : **Water and Waste Water Engineering Lab**
Subject Code : **PCCV-623**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

- CO1: Perform water quality assessments
- CO2: Analyze chemical composition of water samples
- CO3: Calculate optimal treatment doses required for effective water treatment
- CO4: Evaluate bacterial quality of water
- CO5: Apply microscopic techniques for water analysis

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	2	2	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	2	2	2	2	3	1	1	2	2	1	1	2	3	2	2
CO5	2	3	3	2	2	3	1	1	3	2	1	3	3	2	2
Avg.	2.6	2.6	2.4	2.2	2.8	1.8	1.2	1.6	2.8	1.6	1.4	2.6	3	2.2	2.4

List of Experiments:

Physical, chemical and bacteriological characterization of water and chemical dose determination for water treatment by performing following laboratory experiments:

1. To determine the pH value of a given sample of water
2. To determine the turbidity of a given water sample
3. To determine free residual chlorine in a given sample of water
4. To determine the conductivity of a given water sample
5. To determine the chloride concentration in a given sample of water
6. To determine the optimum coagulant dose
7. To determine the temporary and permanent hardness in a given water sample.
8. To determine the chlorine dose required for a given water sample
9. To determine the dissolved oxygen (DO) in a given sample of water.
10. To determine the MPN coliform per 100 ml of a given sample of water

Rahul

Prof. Dr. R. S. R.

Dr. Re¹⁰⁶

Dr. Rajinder Singh

Title of the course : **Technical Communication**
 Subject Code : **HSMC-601**

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Understand importance of Technical communication
 CO2: Be able to draft different kinds of technical documents
 CO3: Draft Business letters, Notices, Agenda, Minutes of Meetings and Memos
 CO4: Draft Applications for Jobs
 CO5: Prepare effectively for job interviews

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	3	2
CO2	2	3	3	3	2	1	2	1	1	1	3	1	2	2	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	3	3	3
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	2	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	3	3	3
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	2.4	2.6	2.4

Theory:

Unit	Main Topics	Course Description	Lecture(s)
Unit-1	Technical Documents: Design and Development	- Importance of Technical communication - Different Kinds of Technical Documents: Style and Appearance - Structure of Reports, Technical Proposals, Research Papers	08
	Technical Writing: Grammar and Editing	- Basics of Grammar - Summarizing and Précis writing - Proof reading and Editing	08
Unit-2	Business Communication	- Business Letters-Placing, Cancelling orders, Complaints, Reply to Complaints - Notices, Agenda, Minutes of Meetings - Writing Memorandum	08

	Career Oriented Communication	• Resume and Bio-data- Design and style; Applying for a job; Language and format of a job application • Job Interviews- Purpose and process; how to prepare for an interview; language and style to be used in an interview; types of interview questions and how to answer the.	08
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Total=32**Recommended Books:**

1. Beer, David F. and David McMurrey, Guide to writing as an Engineer, Wiley. New York, 2004
2. Mishra, Sunita & C. Muralikrishna. Communication Skills for Engineers. Pearson.
3. Bhattacharya, Indrajit. An Approach to Communication Skills. Dhanpat Rai & Co.
4. Sharma, R.C. & Krishna Mohan. Business Correspondence and Report Writing. Tata McGraw-Hill.

Rohit Singh 28/12/2024 108 Shubh Rajinder Singh

Title of the course : **Technical Communication Lab**
Subject Code : **HSMC-602**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1:** Understand Concepts of Communication
CO2: Improve Communication Skills
CO3: Make oral presentations and be able to use multimedia
CO4: Participate effectively in group discussions, debates and job interviews
CO5: Adopt social and professional communication etiquettes

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	3	2
CO2	2	3	3	3	2	1	2	1	1	1	3	1	3	3	3
CO3	3	3	2	3	2	2	1	1	2	3	2	2	3	3	3
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	2	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	2	3	3
Avg.	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	2.4	2.8	2.6

List of Activities of Lab:

1. Reflecting upon Self and Analyzing Environment.
2. Reading and Improving upon Vocabulary with the Help of Newspapers
3. Collecting and Using Library Resources.
4. Giving Individual Oral Presentations (Will Require Multiple Sessions)
5. English Conversation Skills and Speaking Practice
6. Group Discussions/Debates/Extempores
7. Summarizing a Given Short Story
8. Summarizing Newspaper Reports and Events
9. Role Plays/Mock Events
10. Grammar Exercises
11. Finalization of Team Project Work.
12. Collecting Materials for Project Work & Finalization of Project.
13. Presentation of Project

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Title of the course : Irrigation Engineering
Subject Code : PCCV - 711

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Explain the types and methods of irrigation, including the concept and advantages of smart irrigation systems.
- CO2: Analyze the water requirements of crops by understanding soil-moisture relationships, irrigation efficiencies, and concepts like duty and delta.
- CO3: Design canal irrigation systems including canal alignment, discharge estimation, and application of Lacey's and Kennedy's theories, along with drainage solutions for water logging.
- CO4: Describe the components and layout of canal headworks, and design weirs, barrages, and canal head regulators using IS codes and seepage theories.
- CO5: Identify and design various canal regulation and cross drainage works, including canal falls, energy dissipation measures, and CD structures suited to field conditions.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	2	2	2	2	2	1	1	3	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	2	2	2	2	3	3	3	3
CO4	3	2	2	2	3	1	1	2	2	1	1	2	3	2	2
CO5	3	2	2	2	3	2	2	1	2	2	2	2	3	2	2
Avg.	3	2	2.2	2.2	2.8	1.6	1.4	1.6	2.4	1.6	1.6	2.4	3	2.2	2.2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Introduction	Introduction, types and methods of irrigation, concept of smart irrigation systems	6
	Water Requirement of Crops	Soil-moisture-irrigation relationship, depth and frequency of irrigation, irrigation efficiencies, consumptive use and its determination, duty and delta relationship, factors affecting duty, crop seasons.	8
	Canal Irrigation	Canal irrigation system, canal alignment, canal losses, estimation of design discharge of a canal, design of stable channels by Lacey's and Kennedy's theory, Water logging, design of tile drains.	10
Unit-2	Canal Head works	Layout and component parts of a diversion headwork scheme, design of weir/barrage as per IS specifications	8

Radhika *Raj* *SS* *Sn* *Re* *110* *Shubh* *Rajinder* *h* *f*

	Design of Impermeable floor	Causes of failure of hydraulic structures founded on previous foundations, Bligh's creep theory and Khosla seepage theory, hydraulic jump and its applications in the design of hydraulic structures, design of a canal head regulator.	6
	Canal Regulation Works	Canal falls, necessity, location, and types of falls, design of a vertical drop fall and a glacis fall, roughening measures for energy dissipation, cross regulators and distributary's head regulators, canal escape and canal outlets	6
	Cross Drainage (CD) Works	Need, types, selection of suitable CD work, design of CD works	4

Total=48**Recommended Books:**

1. S.K. Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi (2015).
2. P.N.Modi, Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi(2014)
3. Bharat Singh, Fundamentals of Irrigation Engineering, Nem Chand, Roorkee (2005)

Rahul Daye JS JN
 Dr. P. K. III
 Dr. P. K. III
 Rajinder Singh

Title of the course : **Construction Management**
Subject Code : **PCCV - 712**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1:** Apply the principles of quantity surveying to prepare quantity take-offs, bar bending schedules, and detailed cost estimates using MS Excel and standard formats.
- CO2:** Interpret and prepare specifications, units of measurements, and standard schedule of rates for various items of civil engineering works.
- CO3:** Analyze and evaluate rates for different items of work by understanding labor, material, and equipment components in rate analysis.
- CO4:** Explain the types of contracts, tendering procedures (including e-tendering), and financial models such as BOT, DBFOT, PPP, and HAM used in construction projects.
- CO5:** Develop project schedules using bar charts, Gantt charts, CPM and PERT techniques; perform time-cost optimization and resource allocation using network techniques and software tools

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	3	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	3	3	3	2	3	1	1	2	2	1	1	2	3	2	2
CO5	3	3	3	3	2	2	1	1	2	2	2	3	3	3	2
Avg.	3	3	3	2.4	2.8	1.6	1.2	1.6	2.6	1.6	1.6	2.6	3	2.4	2.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Quantity Surveying and Cost Estimation	Quantity survey measurements, Bill of quantities, analysis of rates for different items of work, Specifications and Units of different items of work, Detailed Estimate of various items of Building and Pavements using MS Excel, Common schedule of rates for different items of works, Bar Bending Schedule	12
	Contracts	Types of contracts and their characteristics, procedure for tendering/e-tendering and contracts, BOT, DBFOT, PPP & HAM financial models, evaluation and examination of tenders, award of work, Joint Ventures, Concession	12

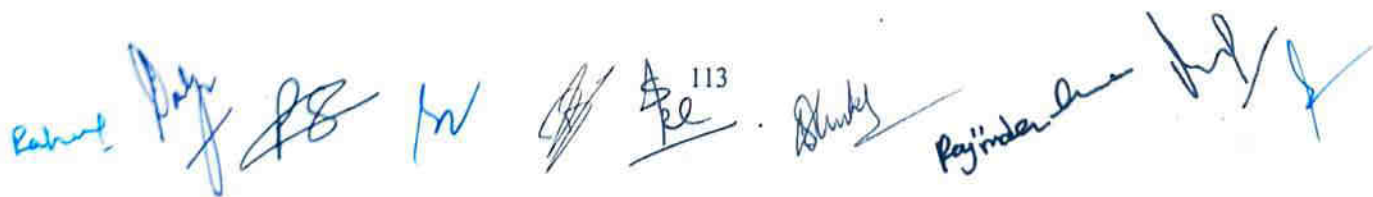
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		Agreements,	
Unit-2	Network Techniques	Methods of Scheduling-Gantt Chart, Bar chart, Development of Bar charts and Gantt chart, Merits & limitations of Bar chart & Gantt chart. Concept of CPM & PERT: Introduction to Critical path method (CPM), Program evaluation & review techniques (PERT), Network Diagramming of Projects Activity-on arrow (AOA) Diagrams- Concept of Activity and Event, Time-Analysis of Networks- Forward Pass, Backward Pass, Probabilistic Durations- Optimistic Time, Pessimistic Time, Most Likely Time, Project Scheduling- ES and LS Schedules as Limits, Resource Scheduling, Time/Cost Trade-off Definitions, functions & characteristics of project planning and principles of project Planning and Management, Bar milestone charts, Planning and scheduling with PERT / CPM, Time cost optimization, Probability concepts Allocation of resources and resource levelling, Updating, Application of software for Project planning, scheduling	24

Total=48

Recommended Books:

1. Seetharaman S., Construction Engineering and Management, Umesh Publication Delhi (2017)
2. Punima B. C. and Khandelwal; Project Planning and Control with PERT and CPM, Laxmi Publication New Delhi (2016)
3. K.K. Chitkara, Construction project management: planning, scheduling and controlling, Tata McGraw-Hill.(2014)
4. L.S. Srinath, PERT and CPM Principles and Application, Third edition, Affiliated east-west press Pvt Ltd (2001)



Title of the course : **Construction Management**
Subject Code : **OECV – 711 A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Prepare detailed estimates, bill of quantities, rate analysis, specifications, and bar bending schedules for building and pavement works using manual methods and MS Excel.
- CO2: Interpret and apply the common schedule of rates and units for various civil engineering works in accordance with standard practices.
- CO3: Understand the types of contracts, tendering and e-tendering procedures, financial models (BOT, DBFOT, PPP, HAM), and the process of evaluation and award of contracts.
- CO4: Develop and interpret project schedules using bar charts, Gantt charts, milestone charts, and apply principles of project planning and resource allocation.
- CO5: Apply network techniques like CPM and PERT for project scheduling, including time-cost trade-off analysis, probabilistic time estimates, and resource levelling, using both manual and software-based approaches.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	3	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	3	3	3	2	3	1	1	2	2	1	1	2	3	2	2
CO5	3	3	3	3	2	2	1	1	2	2	2	3	3	3	2
Avg.	3	3	3	2.4	2.8	1.6	1.2	1.6	2.6	1.6	1.6	2.6	3	2.4	2.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Quantity Surveying and Cost Estimation	Quantity survey measurements, Bill of quantities, analysis of rates for different items of work, Specifications and Units of different items of work, Detailed Estimate of various items of Building and Pavements using MS Excel, Common schedule of rates for different items of works, Bar Bending Schedule	12
	Contracts	Types of contracts and their characteristics, procedure for tendering/e-tendering and contracts, BOT, DBFOT, PPP & HAM financial models, evaluation and examination of tenders, award of work, Joint Ventures, Concession Agreements,	12

Unit-2	Network Techniques	Methods of Scheduling-Gantt Chart, Bar chart, Development of Bar charts and Gantt chart, Merits & limitations of Bar chart & Gantt chart. Concept of CPM & PERT: Introduction to Critical path method (CPM), Program evaluation & review techniques (PERT), Network Diagramming of Projects Activity-on arrow (AOA) Diagrams- Concept of Activity and Event, Time-Analysis of Networks- Forward Pass, Backward Pass, Probabilistic Durations- Optimistic Time, Pessimistic Time, Most Likely Time, Project Scheduling- ES and LS Schedules as Limits, Resource Scheduling, Time/Cost Trade-off Definitions, functions & characteristics of project planning and principles of project Planning and Management, Bar milestone charts, Planning and scheduling with PERT / CPM, Time cost optimization, Probability concepts Allocation of resources and resource levelling, Updating, Application of software for Project planning, scheduling	24
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Total=48

Recommended Books:

1. Seetharaman S., Construction Engineering and Management, Umesh Publication Delhi (2017)
2. Punima B. C. and Khandelwal; Project Planning and Control with PERT and CPM, Laxmi Publication New Delhi (2016)
3. K.K. Chitkara, Construction project management: planning, scheduling and controlling, Tata McGraw-Hill.(2014)
4. L.S. Srinath, PERT and CPM Principles and Application, Third edition, Affiliated east-west press Pvt Ltd (2001)

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Title of the course : **Environment Law and Policy**
Subject Code : **OECV-711 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1:** Demonstrate substantive knowledge of the major environmental laws and policies currently in place at the national and international levels.
CO2: Describe the process of environmental policy development for decision makers.
CO3: Apply environmental ethics theory to real-world environmental conflicts and issues.
CO4: Develop competence in problem-based practice in the application of the law
CO5: Develop critical thinking about the integration of science, ethics and law for achieving sustainable development goals.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	2	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	2	3	2	2	3	1	1	2	2	1	2	2	3	2	2
CO5	3	3	2	2	3	2	1	1	3	2	2	3	3	2	3
Avg.	2.8	2.8	2.2	2.2	3.0	1.6	1.2	1.6	2.8	1.6	1.8	2.6	3.0	2.2	2.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Basic Concepts in Environmental Law	An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL-liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts.	10
	Forest, Wildlife and Biodiversity related laws	Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence 2 Statutory frame work on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006.	10

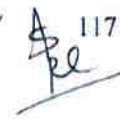
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		Strategies for conservation Project Tiger, Elephant, Rhino, Module leopard.	
Unit-2	Air, Water and Marine Laws	National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act, 1981; EPA, 1986	10
	Environment protection laws and large Projects	Legal framework on environment Protection-Environment Protection Act as the framework legislation—strength and weaknesses; EIA; National Green Tribunal The courts infrastructure projects	10
	Hazardous Substances and Activities	Legal framework: EPA and rules made thereunder; PLI Act, 199 Principles of strict and absolute liability	8

Total=48

Recommended Books

1. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
2. Desai A. (2002) Environmental Jurisprudence, 2nd ed., Modern Law House, Allahabad

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Title of the course
Subject Code

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

Course Outcomes:
After successful completion of course, the students should be able to

- CO1: Characterize and specify advanced construction materials for thermal and sound insulation, smart materials and plastic and timber products.
- CO2: Identify Special Concretes used in construction industry for specific applications.
- CO3: Identify and Specify construction techniques for earthwork, tunneling and formwork.
- CO4: Identify the various construction techniques for High Rise Buildings.
- CO5: Know how to Design Low Cost Housing and cost analysis of In- Situ Pre-Cast, Pre- Fabricated and Modular construction.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Pre-requisite knowledge:															
CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	2	2	2	2	3	2	1	1	3	2	2	2	3	2	3
CO3	3	2	3	3	2	2	2	2	2	2	2	3	2	3	3
CO4	2	2	2	2	3	1	1	2	2	1	1	2	3	2	2
CO5	2	3	2	3	3	2	1	1	3	2	2	3	3	2	3
Avg.	2.2	2.2	2.2	2.4	2.8	1.6	1.2	1.6	2.6	1.6	1.6	2.6	2.8	2.2	2.6

Theory

Theory			
Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Advanced Construction Materials	Plastics, Timber products and Preservation, materials for thermal insulation, materials for sound insulation. Smart Materials and their applications.	6
	Special Concretes	Light Weight Concrete, Vacuum Concrete, Waste Material Based Concrete, Fiber reinforced concrete, Polymer Concrete Composites, Ferro cement, concreting at High and Low Temperatures, Self- Compacting Concrete (SCC), Ready Mixed Concrete (RMC) and its characteristics and advantages, Shotcrete and concreting in tunnels.	10
	Techniques for Tunnelling and Formwork	Earthwork including cut and cover method, TBM,EBM and trenchless technology, Slip Form Shuttering, Latest type of Formwork, e.g. DOKA.	8
Unit-2	High Rise Structures	Construction techniques for high rise buildings, chimneys, dams. Special problems of high-rise construction & optimization of space.	6

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Fire Resistance in Structures	Fire hazards in buildings and preventive measures	6
Low Cost Housing	Types, Design and advantages.	6
Special Constructions	Pre-Cast and Pre-Fabricated Construction and Modular Construction, production and utilization in various types of structures, Environmental and Economic Benefits.	6

Total=48

Recommended Books:

1. M.L. Gambhir, Neha Jamwal, Building Materials, Products, properties and systems, McGraw Hill (2011)
2. M.L. Gambhir, Concrete Technology, McGraw Hill(2013)
3. Subir Sarkar, Subhajit Sarawati, Construction Technology, Oxford University Press (2008).

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Title of the course : **Advanced Concrete Design**
Subject Code : **PECV- 711 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Design combined footings (rectangular, trapezoidal, strap, and raft) and understand pile foundation basics.
- CO2: Analyze and design cantilever retaining walls with stability checks; understand the concept of counterfort retaining walls.
- CO3: Design circular and rectangular water tanks resting on ground, and understand design concepts of overhead and Intze tanks.
- CO4: Analyze and design circular beams curved in plan with symmetrical column supports.
- CO5: Understand IS code provisions and design flat slabs with proper reinforcement detailing.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	2	3	2	2	2	2	1	2	2	2	2	2	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	2	2	2	2	3	1	1	2	2	1	1	2	2	2	2
CO5	3	2	3	2	3	2	2	2	2	1	2	2	2	2	2
Avg.	2.6	2.4	2.6	2.2	2.8	1.6	1.6	1.8	2.4	1.4	1.6	2.4	2.4	2.2	2.4

Theory

Unit	Main Topics	Course Description	Lecture(s)
Unit-1	Combined Footings	Different types, design of rectangular, trapezoidal, strap and raft footings, Pile Foundations	10
	Retaining Walls	Types, behavior, stability requirements, design of cantilever type retaining walls. Introduction to counterfort type retaining wall	8
	Water Tanks	Introduction, general design requirements on no crack basis, Design of circular and rectangular tanks resting on ground, Design philosophy for design of overhead tanks, introduction to Intze type tanks and their staging and foundation	12
Unit-2	Beams curved in plan	Reinforced Concrete Design Circular beam loaded uniformly and supported on symmetrically placed columns	10

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	Flat Slabs	Introduction and Terminology, IS Code Provisions, Analysis and Design of Flat Slab, Reinforcement Detailing	8
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Total = 48**Recommended Books:**

1. Jain, A.K., Reinforced Concrete-Limit State Design, Nem Chand & Bros (2012)
2. Varghese, P. C., Limit State Design of Reinforced Concrete, PHI Publishers (2016).

Rahul Pp JS W ~~JS~~ ¹²¹ ~~JS~~ Shukla Rajinder Singh, S

Title of the course : Seismic Resistant Design of Structures
Subject Code : PECV – 712 A

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to:

- CO1: Analyze free vibrations in single degree of freedom systems
- CO2: Evaluate damped vibrations in mechanical systems
- CO3: Understand earthquake resistant design principles
- CO4: Perform lateral load analysis using seismic codes
- CO5: Design and detail concrete structures for seismic resistance

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	3	3	3	3	2	1	1	3	2	2	2	3	2	3
CO3	3	3	2	3	3	2	2	2	3	2	2	3	3	3	3
CO4	3	3	3	3	3	1	1	2	2	1	1	2	3	2	2
CO5	3	3	3	3	2	2	1	1	2	2	2	2	3	1	2
Avg.	2.8	2.8	2.6	2.8	2.8	1.6	1.2	1.6	2.6	1.6	1.6	2.4	3	2	2.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Earthquake Genesis	Causes of earthquake and propagation, Earthquake occurrence and return period, Characterization of strong ground motions, Seismic hazard assessment, Review of damage in past earthquakes	12
	Introductory Structural Dynamics	Basic concepts of structural vibrations in Single-Degree and Multi-Degree of Freedom systems	12
Unit-2	Seismic Analysis of Buildings	Introduction to Indian Standard IS 1893 (Part-1)-2016, Seismic design philosophy, Design response spectrum, Seismic analysis of buildings—Static and Dynamic analysis procedures using codal provisions. Seismic load combinations; Introduction to analysis of masonry-infilled RC buildings.	12
	Seismic Design of	Concept of ductility for seismic resistance; Capacity based design; Introduction to Indian Standard, IS 13920-2016,	12

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Total=48

1. Pankaj Agarwal, and Manish Shrikhande, Earthquake Resistant Design of Structures, PHI (2022)
2. Mario Paz and William Leigh, Structural Dynamics (Theory and Computation), Kluwer Academic Publishers, London (2004)
3. Srinivas Vasam and K. Jagannadha Rao, Structural Dynamics and Earthquake Engineering, Publisher: S.K. Kataria & Sons, (2018) ISBN 10: 9350146541 / ISBN 13: 9789350146545

Title of the course : **Advanced Steel Structures Design**
Subject Code : **PECV – 712 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Design slab base and gusseted base plates for steel columns under axial load and moment.
- CO2: Analyze and design welded and riveted plate girders, including flange, web, stiffeners, and splices.
- CO3: Design steel roof trusses and industrial building frames, understanding the supporting systems.
- CO4: Understand the concept, components, and advantages of Pre-Engineered Buildings (PEB) over conventional steel structures.
- CO5: Apply IRC and railway bridge codes in the design of steel railway bridges, including stringers, cross girders, and through trusses.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	2	2	2	3	2	1	1	3	2	2	2	2	2	3
CO3	3	3	2	3	3	2	2	1	3	2	2	2	3	3	3
CO4	2	3	3	2	3	1	1	2	2	1	1	2	3	2	2
CO5	2	2	3	2	2	1	2	2	2	1	1	2	2	2	2
Avg.	2.6	2.4	2.6	2.2	2.8	1.4	1.4	1.6	2.6	1.4	1.4	2.2	2.6	2.2	2.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Column Bases	Introduction, slab base, gusseted base, design of column base subjected to axial load and moment	10
	Plate Girders	Introduction, weight and economic depth, design of flanges, design of web, curtailment of flange plates, intermediate and bearing stiffeners, design of a riveted and welded plate girders, web and flange splice.	10
	Industrial Buildings (Steel Structures)	Design of roof trusses and supporting system, Industrial building frames	10
Unit-2	Introduction to Pre-Engineered Buildings (PEB)	Comparison with Conventional Steel Buildings, Components of PEB	8

Rahul *Raj* *SB* *Ar* *124* *Shubh* *Rajinder*

Title of the course : Computer-Aided Civil Engineering Design Lab
Subject Code : PCCV-713

L	T	P	Credits	Weekly Load
0	0	4	2	4

Course Outcomes:

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

CO1: Understand the power and precision of computer-aided modeling and drafting

CO2: Have ability to construct accurate 2D geometry as well as complex 3D shapes and surface objects;

CO3: Have ability to create 2D representations of 3D objects as plan view, elevations and sections;

CO4: Have ability to assemble these drawings in industry-standard plan form and produce plotted hardcopies ready for distribution;

CO5: Have awareness of architectural drafting with a focus on industry standards

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	1	1	2	3	1	1	3	3	2	2
CO2	3	2	3	2	3	2	2	1	3	2	2	2	3	2	3
CO3	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
CO4	2	2	2	2	3	2	2	2	2	1	1	2	3	2	2
CO5	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
Avg.	2.6	2.4	2.4	2.2	3	1.8	1.6	1.6	2.8	1.6	1.6	2.6	3	2.2	2.6

List of Experiments:

1. Intro to CAD, Intro to AutoCAD, Precision Drawing & Drawing Aids, Geometric Shapes, Basic Printing, Editing Tools, Architectural Views & Drafting Views with AutoCAD (Surfaces, Solids), Annotating in AutoCAD with Text & Hatching Layers, and Templates.
2. Advanced plotting (Layouts, Viewports), Office Standards, Dimensioning, Internet and collaboration, Blocks, Drafting symbols, Attributes. Drawing of various components of RCC and Steel constructions.

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Title of the course : **Foundation Engineering**
Subject Code : **PFCEV-721 A**

1	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Understand the importance of soil investigation for any civil engineering construction

CO2: Analyze bearing capacity and shear failure in shallow foundations

CO3: Evaluate settlement and design criteria for shallow foundations

CO4: Design and assess pile foundations

C05: Understand specialized foundations such as drilled piers, caissons and well foundations

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	2	2	2	3	2	1	3	2	2	2
CO2	3	3	3	3	2	2	1	2	3	2	2	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	1	3
CO4	3	3	3	3	3	2	1	2	3	2	2	3	3	1	3
CO5	3	2	1	2	1	2	2	1	2	2	2	3	2	1	2
Avg.	3	2.6	2.4	2.6	2.2	2	1.4	1.8	2.8	2	1.8	3	2.6	1.2	2.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Soil Exploration	Introduction to soil exploration, scope, soil exploration for different structures, spacing, significant depth, boring and sampling techniques, bore hole plan, types of samples, penetration test (SCP and SPT), sample disturbances and Geophysical methods	8
	Earth Pressure	At rest condition, states of plastic equilibrium, Rankine and Coulomb's theories for active and passive conditions, Lateral Earth pressure in layered soils. Stability of cantilever Retaining wall. Introduction to Reinforced Earth Wall	6
	Stability of Slopes:	Infinite slope, types of failure, total and effective stress analysis, Taylor's stability numbers, concept of factors of safety, method of slices, modified method of slices, Swedish's circle method, friction circle method	8
Unit-2	Bearing Capacity	Definitions, introduction to shallow and deep foundation, depth of foundation, Concept of net and gross bearing capacity. Terzaghi's general bearing capacity equation, IS code equation,	6

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		factors affecting bearing capacity. Settlements for clays and sands, permissible settlements, bearing capacity by penetration tests, Influence of eccentric and inclined loads, plate load test	
	Pile Foundations	Types, function, selection of piles, pile driving formulae, equipment, point, and bearing and friction piles. Load carrying capacity of single pile, group action, spacing of piles, Negative skin friction, settlement of pile groups, under-reamed piles	8
	Caissons and Wells	Introduction, components, shapes, Construction and sinking of well, tilts and shifts	6
	Machine Foundation	Definition, types, problem of machine foundation, soil spring constants, General Design Criteria for machine foundation	6

Total=48

Recommended Books:

1. Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.
2. Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.
3. Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age International (P) Ltd. Publishers- N. Delhi, Edition No. - 3rd, 2016.
4. Nainan P Kurian, Design of foundation Systems Principles and Practices, Narosa, 2011
5. Braja M. Das, Principles of Foundation Engineering, Thomson Asia Pvt. Ltd., Singapore, 2005.
6. Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, Geotechnical Engineering, Principles and Practices, PHI Learning Private limited, 2011.
7. Joseph E. Bowles, Foundation Analysis and Design, McGraw-Hill, 1998.
8. P. Purshotam Raj, Geotechnical Engg, Tata McGraw Hill, N. Delhi, Edition No. - I, 1995

Labund *Pdya* *SS* *h* *Re* ¹²⁸ *Shubh* *Pajinda* *hP* *S*

Title of the course : Disaster Preparedness & Planning
Subject Code : PECV- 721 B

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Identify various types of disasters, their causes, effects & mitigation measures.

CO2: Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.

CO3: Understand the use of emergency management system to tackle the problems.

CO4: Discuss the role of media, various agencies and organisations for effective disaster management.

CO5: Design early warning system and understand the utilization of advanced technologies in disaster management.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	3	1	2	2	2	1	3	2	3	3
CO2	2	3	2	1	3	2	1	2	2	2	2	2	3	3	3
CO3	2	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	2	2	2	2	3	2	1	1	3	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	2	3	2	2	3	3	3	3
Avg.	2.2	2.4	2.2	2	2.8	2	1.2	1.8	2.6	1.8	1.6	2.8	2.8	2.6	2.8

Theory

Unit	Main Topic	Course outline	Lecture(s)
Unit-1	Introduction to Disaster Management	Define and describe disaster, hazard, vulnerability, risk-severity, frequency and details, capacity, impact, prevention, mitigation.	6
	Disasters	Identify and describe the types of natural and manmade disasters, hazard and vulnerability profile of India, mountain and coastal areas, Factors affecting vulnerability such as impact of development projects and environment modifications (including dams, land-use changes, urbanization etc.), Disaster impacts (environmental, physical, social, ecological, economic etc.); health, psycho-social issues; demographic aspects (gender, age, special needs), Lessons and experiences from important disasters with specific reference to civil engineering.	12

	Disaster Mitigation and Preparedness	Disaster Management Cycle-its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; Preparedness for natural disasters in urban areas.	6
	Risk Assessment	Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems; Use of Remote Sensing Systems (RSS) and GIS in disaster Management, early warning systems.	6
Unit-2	Post disaster response	Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, waste management, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.	10
	Integration of public policy	Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.	8

Total=48

Recommended Books:

1. Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill, Publisher
2. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester 92
3. Singh B.K., 2008, Handbook of disaster management: Techniques & Guidelines, Rajat Publications.
4. Disaster Management, R.B. Singh (Ed), Rawat Publications
5. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction

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Title of the course : **Advanced Concrete Technology**
Subject Code : **PECV-722 A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Have knowledge about advanced concrete technology

CO2: Learn about strength of concrete and their properties

CO3: Do mix design of concrete by different codes

CO4: Know the concept of high strength concrete

CO5: Learn about special concrete types

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	2	3	1	1	2	3	1	1	3	3	3	2
CO2	3	2	2	2	3	2	1	1	3	2	2	2	3	3	3
CO3	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	3	3	2	2	3	2	2	1	2	2	2	2	3	2	3
CO5	3	3	3	3	2	2	2	2	3	2	2	3	3	3	3
Avg.	2.8	2.4	2.4	2.2	2.8	1.6	1.4	1.6	2.8	1.6	1.6	2.6	3.0	2.6	2.6

Theory

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction	Concrete materials - Cement: Physical tests on cement - Concrete materials - Tests on aggregates - Quality of Water for mixing and curing - use of seawater for mixing concrete. Rheology of concrete- Introduction, Rheological behaviour, Factors affecting rheological properties, mixture adjustments.	10
	Mix Design	Factors influencing mix proportion - Mix design by ACI method and I.S. code method - Design of normal concrete, high strength concrete and self-compacting concrete. Admixtures - accelerating admixtures - Retarding admixtures - water-reducing admixtures - Air entraining admixtures - colouring agent - Plasticizers. Batching - Mixing - Transportation - Placing of concrete - curing of Concrete.	10
Unit-2	Strength of Concrete	Shrinkage and temperature effects - creep of concrete - permeability of concrete - durability of concrete - Corrosion - Causes and effects - remedial measures - Thermal properties of concrete - Micro cracking of concrete, microstructure of concrete.	14

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		Classification of causes of concrete deterioration – Permeability of concrete – Chloride penetration – Acid attack – Sulfate attack – Alkali-aggregate reaction – Concrete in sea water– AC impedance test – Corrosion of embedded steel in concrete – Case histories.	
	Special Concrete	High Performance Concrete (HPC) Introduction – Principles of HPC –Ingredients used for HPC – Production of HPC – Curing of HPC – Mechanism of HPC –Properties of HPC during the fresh and hardened state. Durability of HPC - Acid Attack –Permeability – Scaling resistance – Chloride penetration – Resistance to sea water – sulfate attack – Alkali-aggregate reaction – Fire resistance – Mix design methods of HPC. Special High Performance Concrete-Air-entrained HPC Reactive powder Concrete-Bio concrete-Geo polymer, Fiber reinforced concrete Quality control - Sampling and testing-Acceptance criteria.	14

Total=48

Recommended Books:

1. Shetty, M.S., Concrete Technology, Theory & Practice, S.Chand and Co, 2004.
2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill, 2004.
3. Neville, Properties of Concrete, Longman Publishers, 2004.
4. Santa kumar A.R., Concrete Technology, Oxford University Press, New Delhi, 2007.
5. P.-C. Aïtcin, High Performance Concrete, E &FN SPON, 1998
6. E.G. Nawy, Fundamentals of High Performance Concrete, John Wiley & Sons., 2nd edition, 2000
7. High Performance Concrete Structural Designers Guide published by FHWA, USA, 2005.
8. Geert De Schutter, Peter J.M. Bartos, Peter Domone, John Gibbs, Self-Compacting Concrete, Whittles Publishing, 2008.

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Title of the course : Pre-Stressed Concrete
Subject Code : PECV-722 B

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

- CO1: Explain the basic concepts, terminology, types, and systems of prestressing, and evaluate losses in prestress.
CO2: Apply limit state design principles to prestressed concrete structures considering safety and serviceability.
CO3: Analyze and design prestressed members subjected to axial tension and flexure, using service load and ultimate strength methods.
CO4: Analyze and design prestressed sections for shear and torsion, ensuring proper detailing as per codal provisions.
CO5: Calculate deflections and crack widths, and understand the transmission of prestress in pre-tensioned and post-tensioned members.

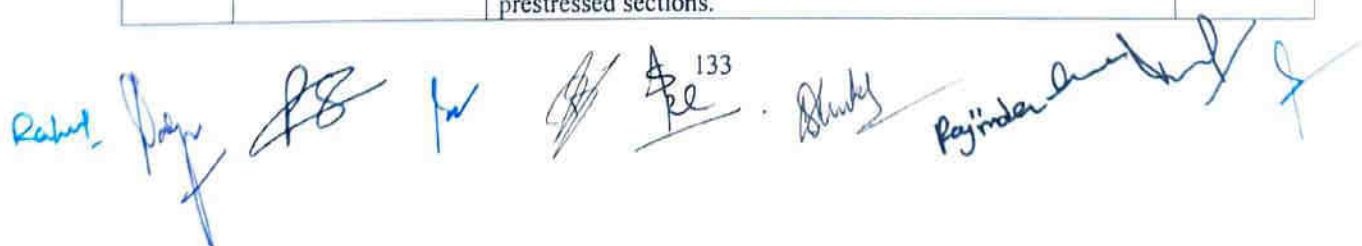
Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Programme Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	2	3	1	1	2	3	1	1	3	3	3	2
CO2	3	2	2	2	3	2	1	1	3	2	2	2	3	3	3
CO3	3	2	2	2	3	1	1	2	3	1	1	3	3	2	2
CO4	3	3	2	2	3	2	2	1	2	2	2	2	3	2	3
CO5	3	3	3	3	2	2	2	2	3	2	2	3	3	3	3
Avg.	2.8	2.4	2.4	2.2	2.8	1.6	1.4	1.6	2.8	1.6	1.6	2.6	3.0	2.6	2.6

Theory

Unit	Main Topics	Course Outlines	Lecture(s)
Unit-1	Introduction-Theory and Basic Concepts	Prestressing concrete terminology, advantages and applications of prestressed concrete, types of prestressing, materials for prestressed concrete and permissible stresses, prestressing systems and devices, losses in prestress.	8
	Limit State Design	Review of limit state design concepts- safety and serviceability requirements.	5
	Analysis and Design for Axial Tension and Flexure	Analysis of members under axial load and flexure, resultant stresses at a section, analysis at service loads-load balancing concept, cracking moment, analysis for ultimate strength, calculation of moment demand, design of type 1 and type 2 members, detailing requirements, analysis of partially prestressed sections.	9



Unit-2	Analysis and Design for Shear and Torsion	Stress in an uncracked beam, limit state of collapse for shear and torsion, design steps and detailing requirements.	8
	Calculations of Deflection and Crack Width	Total deflection due to gravity load and prestressing force, limits of deflection, limits of span-to-effective depth ratio, prediction of long-term deflections, calculation of crack width, limits of crack width.	10
	Transmission of Prestress in pre-tensioned and post-tensioned members	Introduction, transmission length and end zone reinforcement	8

Total=48

Recommended Books:

1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.
2. Pandit G. S. and Gupta S. P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2012.
3. Singh S. B., "Analysis and Design of Prestressed Concrete Structures" Willey, 2023.

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Swami

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Rajinder Ghai

Dr. Rajinder Ghai
S.E, Water Resource Deptt.

Pavitar Singh

Dr. Pavitar Singh
Guest Faculty

Sagar Rohidas Chavan

Dr. Sagar Rohidas Chavan
AsP, IIT, Ropar

Prem Pal Bansal

Dr. Prem Pal Bansal
Prof., TIET, Patiala