

**SCHEME OF EXAMINATION**

**And**

**SYLLABI**

**For**

**BACHELOR OF VOCATION**

**In**

**(REFRIGERATION AND AIR CONDITIONING)**

**BRIDGE COURSE  
LEVEL IV SKILL COMPONENT**

**And**

**1<sup>st</sup> SEMESTER to 2<sup>nd</sup> SEMESTER**

**Offered by**

**University School of Engineering and Technology**



**Guru Gobind Singh Indraprastha University  
Sector 16-C, Dwarka, Delhi – 110078 [INDIA]**

**[www.ipu.ac.in](http://www.ipu.ac.in)**

**NOMENCLATURE OF CODES GIVEN IN THE SCHEME OF B.VOC**

1. **ET** stands for Engineering and Technology.
2. **AP** stands for Architecture and Planning
3. **V** stands for Vocation.
4. **MC** stands for Mobile Communication.
5. **SD** stands for Software Development.
6. **AE** stands for Automobile.
7. **CE** stands for Consumer Electronics.
8. **PT** stands for Printing Technology.
9. **CT** stands for Construction Technology.
10. **RA** stands for Refrigeration & Air-Conditioning.
11. **PD** stands for Power Distribution Management.
12. **ID** stands for Interior Design.
13. **AA** stands for Applied Arts.
14. **CS** stands for Computer Science.
15. **MS** stands for Management Studies.
16. **EN** stands for Environmental Engineering
17. **AS** stands for Applied Science.
18. **HS** stands for Humanities and Social Sciences.
19. **SS** stands for Social Services.
20. **L/T** stands for Lecture and Tutorial
21. **P** stands for Practical.
22. **S/D** stands for Drawing/Studio
23. **P/D** stands for Practical/Drawing



**GURU GOBIND SINGH  
INDRAPRASTHA  
UNIVERSITY**

**TITLE OF THE PROGRAMME**  
**BACHELOR OF VOCATION IN REFRIGERATION AND AIR CONDITIONING**

**Preamble:**

The Refrigeration and Air Conditioning vocational programme provides students with theoretical knowledge and practical training to install, service, maintain and update refrigeration and air conditioning systems. Upon successful completion of the program, the graduate will receive an University Diploma, Advance Diploma & Bachelor Degree in 01 year, 02 years, 03 years respectively. The vocational learning outcomes articulate a range of skills necessary for entry level positions in the refrigeration, and air conditioning industry. Graduates of the program may obtain employment as RAC Senior technicians. Employment may also occur in sales, design, technical support, or as maintenance personnel in residential, commercial, institutional, and industrial settings.

**Aims & Objectives:**

Skill Categories to capture essential skills, the following six categories define the important areas where graduates must demonstrate skills and knowledge.

- i) Communication
- ii) Numeracy
- iii) Critical Thinking & Problem Solving
- iv) Information Management
- v) Interpersonal
- vi) Personal

All graduates of Refrigeration and Air Conditioning become a senior technician with Bachelor degree at par with other Graduation programs of the University. The programs of instruction must have achieved the 3 vocational learning outcomes to provide better employability skills and to develop Entrepreneur skills in the areas of Refrigeration and Air conditioning.

**Program Structure:**

i) Diploma in Refrigeration and Air Conditioning	Duration	01 Year
ii) Advance Diploma in Refrigeration and Air Conditioning	Duration	02 Year
iii) Bachelor of Vocation in Refrigeration and Air Conditioning	Duration	03 Year

**Program outcome:**

a) **Outcome of first year:**

- ❖ Work safely and in accordance with all applicable acts, regulations, legislation, and codes to ensure personal and public safety.
- ❖ Select and use a variety of refrigeration, and air conditioning tools and equipment safely and properly.
- ❖ Operate power and service tools safely and properly including and not limited to reciprocating saws, power-actuated fastener systems, vacuum pumps, gauge manifolds, refrigerant reclaim units, power drills, screw guns, material lifts, and man lifts
- ❖ Operate and read test instruments including and not limited to air velocity meters, compound-gauge meters, pressure meters, temperature sensing meters, flow meters, and electrical meters.

- ❖ Utilize pipe and tubing tools safely and appropriately including and not limited to mechanical benders, flare and swage tools, pipe and tube cutters, reamers, manual and electrical pipe threads, and pipe vises
- ❖ Operate maintenance tools safely and correctly including and not limited to grease guns, manual oilers, aerosol sprays, automatic lubrication systems, and hand and electric oil pumps for adding or removing oil from compressors in refrigeration systems.
- ❖ Use appropriate types of condensers, compressors, evaporators, and metering devices in order to install and maintain refrigeration and air conditioning units.
- ❖ Install or replace relays, pressure switches, flow switches, timers, solenoids, and igniters, as required, for the effective operation of refrigeration, and air conditioning units, and associated components.

**b) Outcome of second year:**

- ❖ Solve math and applied science problems required to effectively install and maintain heating, refrigeration, and air conditioning systems, and associated components.
- ❖ Prepare and interpret electrical, mechanical, and piping drawings
- ❖ Identify and prioritize tasks assigned by supervisors and report on activities completed.
- ❖ Communicate in written, graphic, and oral forms to provide an appropriate degree of detail and accuracy.
- ❖ Employ strategies for good customer relations that build on respect and integrity
- ❖ Apply writing, speaking, and listening skills to develop and strengthen relationships within the field.
- ❖ Summarize and communicate technical information for supervisors, co-workers & customers.
- ❖ Clarify construction project specifications accurately from graphic and written data that may include sketches, drawings, tables, and plans.
- ❖ Identify specific symbols in plans, code Book(s), and specification documents, and interpret project requirements to estimate and construct designs for residential refrigeration, and air conditioning systems that are based upon architectural or engineering blueprints

**b) Outcome of third year:**

- ❖ Relate effectively to Refrigeration, and air conditioning supervisors, co-workers, and customers.
- ❖ Install, service, and troubleshooting, refrigeration, air conditioning systems, and associated components.
- ❖ Develop strategies for ongoing personal and professional development that will lead to enhanced work performance and career opportunities, and keep pace with industry changes.
- ❖ Interpret numerical information for supervisors, co-workers, and customers.
- ❖ Comply with occupational expectations related to appearance and hygiene.
- ❖ Solve a variety of refrigeration, and air conditioning operating problems by applying computer modeling software and technology to correct problems or produce satisfactory building design, cost effective systems, and acceptable indoor environments and air quality.
- ❖ Apply knowledge of basic electricity, control circuits, and mechanical or electrical controls to install, maintain, inspect, or commission air conditioning, and refrigeration systems, and associated components,
- ❖ Adopt computer applications to facilitate communications through the retrieval and interpretation of electronic documents.

**Students will be awarded of Diploma:**

1. Student shall be required to appear in examinations of all courses. However, to award the Diploma (Refrigeration and Air Conditioning) a student shall be required to earn a minimum of **60 credits**.

**Students will be awarded of Advanced Diploma:**

1. Student shall be required to appear in examinations of all courses. However, to award the Advanced Diploma (Refrigeration and Air Conditioning) a student shall be required to earn a minimum of **120 credits**.

**Students will be awarded of B.Voc Degree:**

1. Student shall be required to appear in examinations of all courses. However, to award the degree a student shall be required to earn a minimum of **180 credits**.



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**BACHELOR OF VOCATION  
BRIDGE COURSE FOR (10+2)/10+ITI STUDENTS  
(FOR ALL ENGINEERING DISCIPLINES)  
(FIRST SEMESTER EXAMINATION)  
(LEVEL-IV)**

Paper Code	Paper ID	Paper	L/T/P	Credits
ETVRA401		Module-I*	6	6
ETVRA-403		Module-II*	6	6
<b>TOTAL</b>			<b>12</b>	<b>12</b>

No. of Hours: 12 x 15 Hours =180 Hours

**BACHELOR OF VOCATION  
BRIDGE COURSE FOR (10+2)/10+ITI STUDENTS  
(FOR ALL ENGINEERING DISCIPLINES)  
(SECOND SEMESTER EXAMINATION)  
(LEVEL-IV)**

Paper Code	Paper ID	Paper	L/T/P	Credits
ETVRA-402		Module-III*	6	6
ETVRA-404		Module-IV*	6	6
<b>TOTAL</b>			<b>12</b>	<b>12</b>

No. of Hours: 12 x 15 Hours =180 Hours

\*Non University Examination System (NUES)

**NOTE I:**

The institute is advised to teach/provide relevant skills through Module I to IV, which are pre-requisite for first year of B.Voc.

OR

Relevant qualification pack in alignment with NSQF Level IV may be taught by the institute, which is pre-requisite for B.Voc.

**NOTE II:**

Bridge course is to be taught during first year. Evaluation for bridge course modules will be in Non University Examination System (NUES) pattern. Each module will be of 100 marks.

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**BACHELOR OF VOCATION  
(REFRIGERATION AND AIR CONDITIONING)  
FIRST SEMESTER EXAMINATION  
(LEVEL-V)**

Paper Code	Paper ID	Paper	L	T/P	Credits
<b>THEORY PAPERS</b>					
ETVRA-501		Basics of Thermodynamics	3	0	3
ETVRA-503		Refrigeration-I	3	0	3
ETVHS-519		Communication Skills (Common to all disciplines)	2	1	3
<b>OPEN ELECTIVE-I (Select any one)</b>					
ETVAS-507		Applied Mathematics	3	0	3
ETVCS-509		Data Analysis and Discrete Mathematics	3	0	3
ETVAS-511		Aptitude & Logical Reasoning	3	0	3
ETVME-501		Applied Mechanics	3	0	3
<b>GENERAL ELECTIVE-I (Select any one)</b>					
ETVHS-513		Human Values and Professional Ethics	2	0	2
ETVHS-515		Life Skills	2	0	2
ETVHS-517		Personality Development & Behavioural Science	2	0	2
<b>PRACTICAL/VIVA VOCE (Select any one Lab based on OPEN ELECTIVE-I)</b>					
ETVAS-557		Applied Mathematics Lab	0	3	3
ETVCS-553		Data Analysis and Discrete Mathematics Lab	0	3	3
ETVAS-555		Aptitude & Logical Reasoning Lab	0	3	3
ETVME-551		Applied Mechanics Lab	0	3	3
<b>PRACTICAL/VIVA VOCE</b>					
ETVRA-551		Engineering Graphics	0	3	3
ETVRA-553		Refrigeration-I Lab	0	4	4
ETVCS-559		Basic Programming Lab (Common to all disciplines except MC,SD, PT,CT))	0	2	2
ETVRA-559		Vocation Workshop-I (Mechanical)	0	4	4
<b>TOTAL</b>			<b>13</b>	<b>17</b>	<b>30</b>

**NOTE:**

There are five industrial trainings to be carried out by the student(s) in B.Voc course. Industrial Trainings I, III and V will be with weightage of two credits each. These trainings are to be carried out during winter vacations for the duration of two weeks. Industrial Trainings II and IV will be with weightage of four credits each. These trainings are to be carried out during summer vacations for the duration of four to six weeks. These training may be done from industry/Skill Knowledge Providers (SKPs) /Sector Skill Councils (SSCs) / Training Centers/Institutes. Student should submit training report during evaluation. Industrial Training done at the end of the semester will be evaluated in the subsequent semesters.

**BACHELOR OF VOCATION  
(REFRIGERATION AND AIR CONDITIONING)  
SECOND SEMESTER EXAMINATION  
(LEVEL-V)**

Paper Code	Paper ID	Paper	L	T/P	Credits
<b>THEORY PAPERS</b>					
ETVRA-502		Thermal Engineering	3	0	3
ETVRA-504		Air Conditioning-I	3	0	3
ETVEN-502		Environmental Science (Common to all disciplines)	3	0	3
<b>OPEN ELECTIVE-II (Select any one)</b>					
ETVAS-502		Applied Physics	3	0	3
ETVEC-504		Digital Electronics	3	0	3
ETVEE-508		Basics of Electrical Engineering	3	0	3
ETVME-510		Engineering Materials	3	0	3
<b>PRACTICAL/VIVA VOCE (Select any one Lab based on OPEN ELECTIVE-II)</b>					
ETVAS-552		Applied Physics Lab	0	2	2
ETVEC-554		Digital Electronics Lab	0	2	2
ETVEE-558		Basics of Electrical Engineering Lab	0	2	2
ETVME-560		Engineering Materials Lab	0	2	2
<b>PRACTICAL/VIVA VOCE</b>					
ETVRA-552		Thermal Engineering Lab	0	4	4
ETVRA-554		Air Conditioning-I Lab	0	4	4
ETVEN-552		Environmental Science Lab / Field work (Common to all disciplines)	0	2	2
ETVRA-556		Project-I (RAC)	0	6	3
ETVRA-558		Industrial Training-I	0	0	2
ETVRA-560		Vocation Workshop-II (RAC)	0	3	3
<b>TOTAL</b>			<b>12</b>	<b>21</b>	<b>32</b>

**NOTE:**

There are five industrial trainings to be carried out by the student(s) in B.Voc course. Industrial Trainings I, III and V will be with weightage of two credits each. These trainings are to be carried out during winter vacations for the duration of two weeks. Industrial Trainings II and IV will be with weightage of four credits each. These trainings are to be carried out during summer vacations for the duration of four to six weeks. These training may be done from industry/Skill Knowledge Providers (SKPs) /Sector Skill Councils (SSCs) / Training Centers/Institutes. Student should submit training report during evaluation. Industrial Training done at the end of the semester will be evaluated in the subsequent semesters.

**NOTE FOR PROJECT:**

The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format, thereafter he/she will have to present the progress of the work through seminars and progress reports

**BASICS OF THERMODYNAMICS**

**Paper Code: ETVRA-501**  
**Paper: Basics of Thermodynamics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:****MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objectives and Pre-requisites: To provide exposure to the students in respects of the basics of different aspects of Thermal engineering with emphasis on various concepts.*

**UNIT-I**

**Basic Concepts:** Introduction to the Basic definitions of Engineering Thermodynamics. Thermodynamic systems: Closed, open and isolated systems. Microscopic and Macroscopic view. Intensive and Extensive properties. Zero<sup>th</sup> law of Thermodynamics. Phase, State, Process, Cycle. Point functions and Path functions. Equation of state. Work and Heat.

**First Law of Thermodynamics:** Internal energy - a property arising from the First Law of Thermodynamics. Reversible Non flow processes p-v diagrams. Concept of Flow work, Enthalpy. Analysis of unsteady flow and steady flow processes and their applications. Throttling process.

**[T1][No. of Hrs. 11]****UNIT-II**

**Second Law of Thermodynamics:** Limitations of First law and necessity of Second Law of Thermodynamics. Clausius and Kelvin Planck statements. Reversible and Irreversible processes. Carnot cycle, Reversed Carnot cycle. Clausius inequality. Entropy - a property arising from the Second law of Thermodynamics. Expressions for change in entropy during various processes and representations on t-s diagrams.

**Availability and Irreversibility:** High grade and low grade energy. Available and unavailable energy. Dead state. Loss of available energy due to Heat transfer through a Finite temperature difference. Availability. Reversible work and Irreversibility. Availability in non flow systems and steady flow systems. Second law efficiency.

**[T1][No. of Hrs.11]****UNIT-III**

**Thermodynamic Property Relations:** Helmholtz and Gibbs function. Mathematical conditions for exact differentials (Properties). Maxwell Relations. Clapeyron Equation.

**Properties of a Pure Substance:** Phase equilibrium of a pure substance on t-v diagram. Normal boiling point of a pure substance. Saturation states. Compressed liquid. p-v & p-t diagram of a pure substance. Saturated steam, Dry and saturated steam, Superheated steam. Use of Steam tables and Mollier diagram. Different processes of vapour on p-v and t-s diagrams. Measurement of Dryness fraction.

**[T1][No. of Hrs.11]****UNIT-IV**

**Gas Power Cycles:** Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycle and Brayton cycle.

**Vapour Power Cycles:** Carnot cycle. Simple Rankine cycle. Effect of various parameters on the efficiency of Rankine cycle. Reheat and Regenerative cycles.

**Air Compressor:** Classification and working principle of various types of compressors, work of compression with/without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor.

**[T1][No. of Hrs.12]****Text Book(s):**

[T1] P.K. Nag, “Engineering Thermodynamics”, Tata McGraw Hill

**Reference Book(s):**

[R1] Sonntag/Vanhyllene, “Fundamentals of Thermodynamics”, Wiley

[R2] Gordon Rosers, “Yon Mahew; Engineering Thermodynamics”, Addison Wesley

[R3] M.L. Mathur, “Mehta F.S. Thermal Engineering”, Jain Brothers

**REFRIGERATION-I****Paper Code: ETVRA-503****Paper: Refrigeration-I**

L	T/P	C
3	0	3

**INSTRUCTIONS TO PAPER SETTERS:****MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objectives and Pre-requisites: To provide exposure to the students in respects of the basics of different aspects of Refrigeration with emphasis on various concepts.*

**UNIT-I**

**Introduction:** definition of Refrigeration, method of refrigeration, Law's of refrigeration principles of refrigeration, unit of refrigeration, coefficient of performance, reversed Carnot cycle, rating of refrigeration machines.

[T1,T2][No. of Hrs.11]

**UNIT-II**

**Vapour compression refrigeration systems:** vapour compression cycle effect of sub cooling and super pressure – enthalpy charts.

[T1,T2][No. of Hrs.11]

**UNIT-III**

**Refrigerants:** Desirable properties of refrigerants, properties and applications of commonly used refrigerants such as R-22, NH<sub>3</sub>, water, R-134a, R-410A, R-32, brine solution. ODP, GWP.

[T1,T2][No. of Hrs.11]

**UNIT-IV**

**Components of vapour compression cycle:** Function, type, specification and constructional details of components such as – compressor, condenser, throttle device, evaporator.

**Accessories:** Various accessories and controls- solenoid valve, thermostat , low pressure cut out, high pressure cut out , oil failure switch , antifreeze control, oil separator, accumulator.

[T1,T2][No. of Hrs.12]

**Text Book(s):**

[T1] P. L. Ballaney, Refrigeration &amp; Air Conditioning, Khanna Publisher

[T2] C.P Arora, Refrigeration &amp; Air Conditioning, Tata Mc Graw Hill

**Reference Book(s):**

[R1] Dossat, Principles of Refrigeration, John Wiley &amp; Sons

GURU GOBIND SINGH  
INDRAPRASTHA  
UNIVERSITY

**COMMUNICATION SKILLS**  
**(Common to All Disciplines)**

**Paper Code: ETVHS-519**  
**Paper: Communication Skills**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>2</b>	<b>1</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

**Objectives and Pre-requisites:** Students should have studied General English up to secondary level and the subject aims at developing communication skills in writing, speaking as well as body language.

**Learning Outcomes:** The students should be able to communicate effectively to his/her superiors as well as juniors at work place in his/her professional field.

**UNIT-I**

Recognizing and Understanding Communication Styles: What is Communication?, Passive Communication, Aggressive Communication, Passive-Aggressive Communication, Assertive Communication, Verbal and Non Verbal Communication, Barriers and Gateways to Communication.

[T1, T2][No. of Hrs. 11]

**UNIT-II**

**Listening Skills:** Types of Listening (theory /definition), Tips for Effective Listening Academic Listening-(lecturing), Listening to Talks and Presentations, Basics of Telephone communication

**Writing Skills:** Standard Business letter, Report writing, Email drafting and Etiquettes, Preparing Agenda and writing minutes for meetings, Making notes on Business conversations, Effective use of SMS, Case writing and Documentation.

[T1, T2][No. of Hrs. 11]

**UNIT-III**

**Soft Skills:** Empathy (Understanding of someone else point of view), Intrapersonal skills, Interpersonal skills, Negotiation skills, Cultural Aspects of Communication.

[T1, T2][No. of Hrs. 11]

**UNIT-IV**

**Group Communication:** The Basics of Group Dynamics, Group Interaction and Communication, How to Be Effective in Groups, Handling Miscommunication, Handling Disagreements and Conflicts, Constructive Criticism.

[T1, T2][No. of Hrs. 12]

**Text Book(s):**

- [T1] Mckay, M., Davis, M. & Fanning, P.(2008). Messages: The Communication Skills Book, New Harbinger Publications
- [T2] Perkins, P.S., & Brown, L. (2008). The Art and Science of Communication: Tools for effective communication in the workplace, John Wiley and Sons

**Reference Book(s):**

- [R1] Krizan et al (2010). Effective Business Communication, Cengage Learning.
- [R2] Scot, O. (2009). Contemporary Business Communication, Biztantra, New Delhi.
- [R3] Chaney & Martin (2009). Intercultural Business Communication, Pearson Education
- [R4] Penrose et al (2009). Business Communication for Managers, Cengage Learning.

**APPLIED MATHEMATICS**  
**(Open Elective-I)**

**Paper Code: ETVAS-507**  
**Paper: Applied Mathematics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objective: The objective of the paper is to facilitate the student with the basics of Applied Mathematics that are required for an engineering student.*

**UNIT- I**

Successive differentiation: Leibnitz theorem for  $n^{\text{th}}$  derivative (without proof). Infinite series: Convergence and divergence of infinite series, positive terms infinite series, necessary condition, comparison test (Limit test), D'Alembert ratio test, Integral Test, Cauchy's root test, Raabe's test and Logarithmic test (without proof). Alternating series, Leibnitz test, conditional and absolutely convergence. Taylor's and Maclaurin's expansion (without proof) of function ( $e^x$ ,  $\log(1+x)$ ,  $\cos x$ ,  $\sin x$ ) with remainder terms, Taylor's and Maclaurin's series, Error and approximation.

[T1], [T2][No. of hrs. 11]

**UNIT- II**

Asymptotes to Cartesian curves. Radius of curvature and curve tracing for Cartesian, parametric and polar curves.

Integration: integration using reduction formula for  $\int_0^{\pi/2} \sin^n \theta d\theta$ ,  $\int_0^{\pi/2} \cos^n \theta d\theta$ ,  $\int_0^{\pi/2} \sin^n \theta \cos^m \theta d\theta$ .  
Application of integration : Area under the curve, length of the curve, volumes and surface area of solids of revolution about axis only .Gamma and Beta functions.

[T1], [T2][No. of hrs. 11]

**UNIT- III**

Matrices: Orthogonal matrix, Hermitian matrix, Skew-Hermitian matrix and Unitary matrix. Inverse of matrix by Gauss-Jordan Method (without proof). Rank of matrix by echelon and Normal (canonical) form. Linear dependence and linear independence of vectors. Consistency and inconsistency of linear system of homogeneous and non homogeneous equations . Eigen values and Eigen vectors. Properties of Eigen values (without proof). Cayley-Hamilton theorem (without proof). Diagonalization of matrix. Quadratic form, reduction of quadratic form to canonical form.

[T1], [T2][No. of hrs. 11]

**UNIT-IV**

Ordinary differential equations: First order linear differential equations, Leibnitz and Bernoulli's equation. Exact differential equations, Equations reducible to exact differential equations. Linear differential equation of higher order with constant coefficients, Homogeneous and non homogeneous differential equations reducible to linear differential equations with constant coefficients. Method of variation of parameters. Bessel's and Legendre's equations (without series solutions), Bessel's and Legendre's functions and their properties.

[T1], [T2][No. of hrs. 12]

**Text:**

- [T1] B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications.  
[T2] R. K. Jain and S.R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications.

**References:**

- [R1] E. Kresyzig, "Advance Engineering Mathematics", Wiley publications  
[R2] G. Hadley, "Linear Algebra", Narosa Publication  
[R3] N.M. Kapoor, "A Text Book of Differential Equations", Pitambar Publication.  
[R4] Wylie R, "Advance Engineering Mathematics", Tata McGraw-Hill  
[R5] Schaum's Outline on Linear Algebra, Tata McGraw-Hill  
[R6] Polking and Arnold, "Ordinary Differential Equation using MATLAB", Pearson.

**DATA ANALYSIS AND DISCRETE MATHEMATICS**  
**(Open Elective-I)**

**Paper Code: ETVCS-509**

**Paper: Data Analysis and Discrete Mathematics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

***Objectives:** To understand the basics concepts of Discrete Mathematical Structures. To get the Knowledge about sets, relations and functions, basics of lattices and graphs. To get familiar with propositional logic.*

**UNIT-I**

**Overview of Data analysis Techniques:** Simple Linear Regression Analysis, Multiple Linear Regression Model, Multi-Collinearity, Variable selection and Model Building, Logistic Regression Models

[T3][No. of Hrs: 11]

**UNIT-II**

**Sets:** Sets, Subsets, Equal Sets Universal Sets, Finite and Infinite Sets, Operation on Sets, Union, Intersection and Complements of Sets, Cartesian Product, Cardinality of Set, Simple Applications.

**Relations and Functions:** Properties of Relations, Equivalence Relation, Partial Order Relation Function: Domain and Range, Onto, Into and One to One Functions, Composite and Inverse Functions, Hashing functions, Recursive function.

[T1][T2][No. of Hrs: 11]

**UNIT-III**

**Partial Order Relations And Lattices:** Partial Order Sets, Representation of POSETS using Hasse diagram, Chains, Maximal and Minimal Point, Glb, lub, Lattices & Algebraic Systems, Principle of Duality, Basic Properties, Sublattices, Distributed & Complemented Lattices.

**Propositional Logic:** Proposition, First order logic, Basic logical operation, truth tables, tautologies, contradictions, Algebra of Proposition, logical implications, logical equivalence, predicates, Universal and existential quantifiers.

[T1][T2][No. of Hrs: 11]

**UNIT-IV**

**Graphs:** Types and operations (bipartite graph. Subgraph, distance of a graph, cut-edges & cut vertices, isomorphic and homomorphic graphs), degree of graphs, adjacent and incidence matrices, path circuit (Floyd's and Warshall algorithms), hamiltonian graph, graph colouring.

[T1][T2][No. of Hrs: 12]

**Text Book(s):**

[T1] Rosen, K.H., Discrete Mathematics and its Applications, McGraw Hill, (2006) 6 th ed.

[T2] Kolman, Busby and Ross, "Discrete Mathematical Structure", PHI, 1996.

[T3] Regression Analysis by Example by Samprit Chatterjee, Wiley

**Reference Book(s):**

[R1] S.K. Sarkar, "Discrete Maths"; S. Chand & Co., 2000.

[R2] Tremblay, J.P. and Manohar, R., Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, (2007).

**APTITUDE & LOGICAL REASONING**  
**(Open Elective-I)**

**Paper Code: ETVAS-511**  
**Paper: Aptitude & Logical Reasoning**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

***Objectives and Pre-requisites:** At the end of the course the students will be able to (a) Interpret different data, (b) Establish relationship between numbers & (c) Solve different logical. To impart students with logical skills to solve problems easily.*

**UNIT-I**

Data sufficiency, Measurement, Time and distance, Arithmetic, Relationship between numbers.

[T1][T2][No. of Hrs. 11]

**UNIT-II**

Basic mathematical relations and formula, Computation, Data interpretation.

[T1][T2][No. of Hrs. 11]

**UNIT-III**

Differences, Discrimination, Decision-making, Judgement, Problem-solving, Analogies, Analysis.

[T1][T2][No. of Hrs. 11]

**UNIT-IV**

Arithmetic reasoning, Relationship concept, Arithmetic number series, Similarities, Verbal and figure classification, Space visualization, Observation.

[T1][T2][No. of Hrs. 12]

**Text Book(s):**

[T1] Arun Sharma, "How to prepare for Logical Reasoning for the CAT".

[T2] A.K. Gupta, "Logical and Analytical Reasoning".

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INDRAPRASTHA  
UNIVERSITY



**APPLIED MECHANICS**  
**(Open Elective-I)**

**Paper Code: ETVME-501**  
**Paper: Applied Mechanics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

**Objectives and Pre-requisites:** The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required to the students for further understanding of other applied subjects. To introduce the concepts of rigid body mechanics for bodies at rest and in motion to students. To make the students appreciate the applications of basic laws of physics to a variety of problems. Inculcating and enhancing analytical skills to solve numerical problems. Upon the completion of course student should be able to understand the importance of mechanics in engineering and various concepts.

**Learning outcomes:** Students will be able to state the relevant laws and apply them to numerical problems. Students will be able to draw free-body diagrams for a given problem and get the required solution. Students will be able to visualize the applications of basic laws in solving numerical problems. Students will be able to correlate the concepts learnt in the relevant courses of higher classes.

**UNIT-I:**

**Introduction-** Concept of mechanics and applied mechanics – Explanation of mechanics and applied Mechanics, its importance and necessity, giving suitable examples on bodies at rest and in motion, explanation of branches of this subject.

**Laws of Forces-** Force and its effects. Units and measurement of force. Characteristics of force vector representation. Bow's notation. Types of forces, action and reaction, tension & thrust. Force systems: Coplanar and space force systems. Coplanar, concurrent and non-concurrent forces. Free body diagrams. Resultant and components of forces, concept of equilibrium; parallelogram law of forces. Equilibrium of two forces, superposition 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-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.

[T1, T2, T3][No. of Hrs: 11]

**UNIT-II:**

**Moments-** Concept of moment, Varignon's theorem – statement only. Principle of moments – application of moments to simple mechanism. Parallel forces, like and unlike parallel forces, calculation of their resultant, concept of couple, moving a force parallel to its line of action, general cases of coplanar force system, general conditions of equilibrium of bodies under coplanar parallel forces.

**Friction-** Concept of friction, laws of friction, limiting friction and coefficient of friction, sliding friction and rolling friction, inclined plane.

[T1, T2, T3][No. of Hrs: 11]

**UNIT-III:**

**Centre of Gravity and Centroid-** Concept of gravity, gravitational force, Centroid and centre of gravity. Centroid for regular lamina and center of gravity for regular solids. Position of centre of gravity of compound bodies and centroid of composite area. CG of bodies and areas with portions removed.

**Moment of Inertia of Plane Areas-** Concept of Moment of Inertia and second moment of area and Radius of gyration, theorems of parallel and perpendicular axes, second moment of area of common geometrical sections: rectangle, triangle, circle (without derivations). Second moment of area for L, T and I sections. Section modulus without derivation.

[T1, T2, T3][No. of Hrs: 11]

**UNIT-IV**

**Laws of Motion-** Concept of momentum, Newton's laws of motion, their application, derivation of force equation from second law of motion, numerical problems on second law of motion, piles, lifts, bodies tied with string,

Newton's third law of motion numerical problems, conservation of momentum, impulse and impulsive force (definition only).

**Simple Lifting Machines-** Concept of machine, mechanical advantage, velocity ratio and efficiency of a machine, their relationship, law of machine, simple machines (lever, wheel and axle, pulleys, jacks winch crabs only).

[T1, T2, T3][No. of Hours: 12]

**Text Book(s):**

[T1] A.K.Tayal, "Engineering Mechanics: Statics and Dynamics", Umesh publications

[T2] R.K. Rajput, "Applied Mechanics", Lakshmi Publications

[T3] A. K. Upadhyay, "Applied Mechanics, Kataria Publications

**References Book(s):**

[R1] Beer and Johnston, "Mechanics for Engineers (Statics and Dynamics)", McGraw Hill Co. Ltd.

[R2] R. S. Khurmi, "Applied Mechanics", S. Chand publications

[R3] Hibbeler R C, "Engineering Mechanics: Statics, Low Price Edition", Pearson Education

[R4] Hibbeler R C, "Engineering Mechanics: Dynamics, Low Price Edition", Pearson Education

[R5] Timoshenko, S.P., and Young, D.H., "Engineering Mechanics", McGraw Hill international

[R6] V.S. Mokashi, "Engineering Mechanics Vol. I and II", Tata McGraw Hill Publishing Co. ltd., New Delhi



**GURU GOBIND SINGH  
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UNIVERSITY**

**HUMAN VALUES AND PROFESSIONAL ETHICS**  
**(General Elective-I)**

**Paper Code: ETVHS-513**

**Paper : Human Values and Professional Ethics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>2</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

**Objectives:** *This introductory course input is intended*

- a. *To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.*
- b. *To facilitate the development of a holistic perspective among students towards life, profession and happiness, based on the correct understanding of the Human reality and the rest of the Existence. Such a Holistic perspective forms the basis of value-based living in a natural way.*
- c. *To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with Nature..*

**UNIT-1: Introduction to Value Education**

1. Understanding the need, basic guidelines, content and process for value education.
2. Basic Human Aspirations: Prosperity and happiness
3. Methods to fulfil the human aspirations – understanding and living in harmony at various levels.
4. Practice Session – 1.

[T1], [R1], [R4][No. of Hrs. 07]

**UNIT-2: Harmony in the Human Being**

1. Co-existence of the sentient "I" and the material body—understanding their needs—Happiness & Conveniences.
2. Understanding the Harmony of "I" with the body—Correct appraisal of physical needs and the meaning of prosperity.
3. Programme to ensure harmony of "I" and Body-Mental and Physical health and happiness.
4. Harmony in family and society: Understanding Human-human relationship in terms of mutual trust and respect.
5. Understanding society and nation as extensions of family and society respectively.
6. Practice Session – 02

[T2], [R1],[R2][No. of Hrs. 08]

**UNIT-3: Basics of Professional Ethics**

1. **Ethical Human Conduct** – based on acceptance of basic human values.
2. **Humanistic Constitution and universal human order** – skills, sincerity and fidelity.
3. **To identify the scope and characteristics of people** – friendly and eco-friendly production system, Technologies and management systems.
4. Practice Session – 03.

[T1],[R4] ][No. of Hrs. 07]

**UNIT-4: Professional Ethics in practice**

1. **Profession and Professionalism** – Professional Accountability, Roles of a professional, Ethics and image of profession.
2. **Engineering Profession and Ethics** - Technology and society, Ethical obligations of Engineering professionals, Roles of Engineers in industry, society, nation and the world.
3. **Professional Responsibilities** – Collegiality, Loyalty, Confidentiality, Conflict of Interest, Whistle Blowing
4. Practice Session – 04

[T1], [T2], [T3], [R3][No. of Hrs. 08]

**Text Book(s):**

- [T1] Professional Ethics, R. Subramanian, Oxford University Press.
- [T2] Professional Ethics & Human Values: [Subhash Bhalchandra Gogate](#), Vikas publication
- [T3] Professional Ethics & Human Values: Prof. D.R. Kiran, TATA Mc Graw Hill Education.
- [T4] Professional Ethics & Human Values: S.B. Srivastha, SciTech Publications (India) Pvt. Ltd. New Delhi.

**References Book(s):**

- [R1] Success Secrets for Engineering Students: Prof. K.V. SubbaRaju, Ph.D., Published by SMART student.
- [R2] Ethics in Engineering Mike W. Martin, Department of Philosophy, Chapman University and Roland Schinzinger, School of Engineering, University of California, Irvine.
- [R3] Human Values: A. N. Tripathy (2003, New Age International Publishers)
- [R4] Value Education website, <http://www.universalhumanvalues.info>[16]
- [R5] Fundamentals of Ethics, Edmond G. Seebauer & Robert L. Barry, Oxford University Press.
- [R6] Human Values and Professional Ethics: R. R. Gaur, R. Sangal and G. P. Bagaria, Eecl Book(s) (2010, New Delhi). Also, the Teachers" Manual by the same author.

**\*PRACTICAL SESSIONS OF 14 HOME ASSIGNMENTS** will be followed by the students pursuing this paper. (Ref: Professional Ethics & Human Values: S.B. Srivastava, SciTech Publications (India) Pvt. Ltd. New Delhi. )

**CONTENT OF PRACTICE SESSION****Module 1: Course Introduction – Needs, Basic Guidelines, Content and Process of Value Education**

**PS-1:** Imagine yourself in detail. What are the goals of your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcoming in your life? Observe and analyze them.

**Expected Outcome:**

The students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.

**PS-2:** Now a days there is lot of voice about techno-genie maladies such as energy and natural resource depletion, environmental Pollution, Global Warming, Ozone depletion, Deforestation, etc. – all these scenes are man-made problems threatening the survival of life on the earth – what is root cause of these maladies and what is the way out in your opinion?

On the other hand there is rapidly growing danger because of nuclear proliferation, arm race, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression and suicidal attempts, etc - what do you think the root cause of these threats to human happiness and peace – what could be the way out in your opinion?

**Expected Outcome:**

The students start finding out that technical education with study of human values can generate more solutions than problems. They also start feeling that lack of understanding of human values is the root cause of all the problems and the sustained solution could emerge only through understanding of human values and value based living. Any solutions brought out through fear, temptation or dogma will not be sustainable.

**PS-3:** 1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of following:

- a) What is naturally acceptable to you in relationship – feeling of respect or disrespect?
- b) What is naturally acceptable to you - to nurture or to exploit others? Is your living the same as your natural acceptance or different?

2. Out of three basic requirements for fulfillment of your aspirations, right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time and efforts you devote for each in your daily routine.

**Expected Outcome:**

1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify the right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity, it will only develop assumptions.
2. The students are able to see that their practice in living is not in harmony with their natural acceptance at most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.
3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of the problems in their family and the lack of physical facilities in most of the cases; while they

have given higher priority to earning of physical facilities in their life ignoring relationship and not being aware that right understanding is the most important requirement for any human being.

## Module 2: Understanding harmony in human being – Harmony in myself!

**PS-4:** Prepare the list of your desires. Observe whether the desires are related with self “I” or body. If it appears to be related with the both, see which part of it is related to self “I” and which part is related to body.

### Expected Outcome:

The students are able to see that they can enlist their desires and the desires are not vague, also they are able to relate their desires to “I” and “body” distinctly. If, any desire appears to be related with both, they are able to see that feeling is related to “I” while the physical facility is related to the body. They are also able to see that “I” and “body” are two realities, and most of their desires are related to “I” and not with the “Body”; while their efforts are mostly connected on the fulfillment of the need of the body assuming that it will meet the needs of “I” too.

### PS-5:

1. {A}. Observe that any physical facilities you use, follows the given sequence with time; Necessary and tasteful – unnecessary & tasteful – unnecessary & tasteless.  
{B}. In contrast, observe that any feelings in you are either naturally acceptable or not acceptable at all. If, naturally acceptable, you want it continuously and if not acceptable, you do not want it at any moment.
2. List Down all your activities. Observe whether the activity is of “I” or of “body” or with the participation both “I” and “body”.
3. Observe the activities with “I”. Identify the object of your attention for different moments (over a period say 5 to 10 minute) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

### Expected Outcome:

1. The students are able to see that all physical facilities they use are required for limited time in a limited quantity. Also they are able to see that cause of feeling, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.
2. The students are able to see that activities like understanding, desires, thoughts and selection are the activities of “I” only; the activities like breathing, palpitation of different parts of the body are fully the activities of the body. With the acceptance of “I”, while activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs, etc. are such activities that require the participation of both “I” and “body”.
3. The students become aware of their activities of “I” and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

### PS-6:

1. Chalk out the program to ensure that you are responsible to your body – for the nurturing, protection and right utilization of the body.
2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

### Expected Outcome:

The students are able to list down activities related to a proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing the different diseases.

### Module 3: Understanding harmony in the family and society - Harmony in Human – Human relationship

**PS-7:** Form small groups in the class and in that group initiate the dialogue and ask the eight questions related to trust. The eight questions are-

S.No.	Intention (Natural Acceptance)	S.No.	Competence
1.a.	Do I want to make myself happy?	1.b.	Am I liable to make myself always Happy?
2.a.	Do I want to make the other happy?	2.b.	Am I liable to make the other always happy?
3.a.	Does the other want to make him happy?	3.b.	Is the other able to make him always happy?
4.a.	Does the other want to make me happy? What is answer?	4.b.	Is the other able to make me always happy? What is answer?

Let each student answer the question for himself and everyone else. Discuss the difference between intention and competence.

#### Expected Outcome:

The students are able to see that the first four questions are related to our natural acceptance i.e. intention and the next four to our competence. They are able to note that the intention is always correct, only competence is lacking. We generally evaluate ourselves on the basis of our intention and other on the basis of their competence. We seldom look at our competence and other's intention as a result we conclude that I am a good person and other is a bad person.

#### PS-8:

1. Observe that on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasion you are disrespecting by way of under evaluation, over evaluation or otherwise evaluation.
2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

#### Expected Outcome:

The students are able to see that respect is right evaluation and only right evaluation leads to fulfilment of relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect) like gender biasness, generation gap, caste conflicts, class struggle, and domination through poor play, communal violence, and clash of isms and so on so forth.

All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

#### PS-9:

1. Write a note in the form of a story, poem, skit, essay, narration, dialogue, to educate a child.  
Evaluate it in a group.
2. Develop three chapters to introduce "social science", its needs, scope and content in the primary education of children.

#### Expected Outcome:

The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

### Module 4: Understanding harmony in the nature and existence – Whole existence as Co – existence -

**PS-10:** Prepare the list of units (things) around you. Classify them into four orders. Observe and explain the mutual fulfilment of each unit with other orders.

**Expected Outcome:**

The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them. They are also able to see that human beings are not fulfilling to their orders today and need to take appropriate steps to ensure right participation (in term of nurturing, protection and right utilization) in the nature.

**PS-11:**

1. Make a chart for the whole existence. List down different courses of studies and relate them to different or levels in the existence.
2. Choose any one subject being taught today. Evaluate and suggest suitable modifications to make it appropriate and holistic.

**Expected Outcome:**

The students are confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are liable to make out how these courses can be made appropriate and holistic.

**Module 5: Implication of the above Holistic Understanding of Harmony at all Levels of Existence.**

**PS-12:** Choose any two current problem of different kind in the society and suggest how they can be solved on the basis of the natural acceptance of human values. Suggest the steps you will take in present conditions.

**Expected Outcome:**

The students are liable to present sustainable solutions to the problem in society and nature. They are also able to see that these solutions are practicable and draw road maps to achieve them.

**PS-13:**

1. Suggest ways in which you can use your knowledge of engineering / technology / management for universal human order from your family to world family.
2. Suggest one format of humanistic constitution at the level of nation from your side.

**Expected Outcome:**

The students are able to grasp the right utilization of their knowledge in their streams of technology / engineering / management to ensure mutually enriching and recyclable production systems.

**PS-14:** The course is going to be over now. Evaluate your state before and after the course in terms of-

- Thoughts
- Behaviour
- Work and
- Realization

Do you have any plan to participate in the transition of the society after graduating from the institute? Write a brief note on it.

**Expected Outcome:**

The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for happy and prosperous society.

**LIFE SKILLS)**  
**(General Elective-I)**

**Paper Code: ETVHS-515**  
**Paper: Life Skills**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>2</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

**Objectives and Pre-requisites:** Students should have studied subjects such as General languages, social studies and Moral education at school level. The objective of this subject is to prepare the students to become a good citizen and a professional useful to the society.

**Learning Outcomes:** The knowledge of this subject will give the student a value system which will help him in taking decisions in professional and social life for the benefit of society at large.

**UNIT-I**

**Introduction:** Definition and importance of Life Skills, Livelihood Skills, Survival Skills, Life Skills Approach, Life Skills based education, Life Skills Training- Implementation Models

[T1,T2][No. of Hrs. 07]

**UNIT-II**

Learning and Performance, Cognitive Development, Maturation, Adult Learning, Approaches to Learning Pillars of Education and Life Skills- Four Pillars: Learning to Know, Learning to Do, Learning to Live Together, Learning to be learning throughout Life

[T1,T2][No. of Hrs. 08]

**UNIT-III**

**Social Skills and Negotiation Skills:** Self Awareness, Empathy, Effective Communication, Interpersonal Relationships

**Thinking Skills:** Nature, Element of Thought, Types, Concept Formation, Reasoning, Creative and Critical Thinking

[T1,T2][No. of Hrs. 08]

**UNIT-IV**

**Coping Skills:** Coping with Emotions, Coping with Stress, Integrated use of thinking skills, social skills and coping skills

[T1,T2][No. of Hrs. 07]

**Text Book(s):**

- [T1] Rajasenan, N.V. (2010). Life Skills, Personality and Leadership, Rajiv Gandhi National Institute of Youth Development, TamilNadu
- [T2] Duffy, Grover,K., Eastwood, A. (2008). Psychology for Living-Adjustment, Growth and Behaviour Today, Pearson Education

**Reference Book(s):**

- [R1] Debra McGregor, (2007), "Developing Thinking; Developing Learning - A Guide to Skills in Education", Open University Press, New York, USA
- [R2] Singh Madhu, (2003). "Understanding Life Skills, Background paper prepared for Education for All: The Leap to Equality"
- [R3] Nair. A. Radhakrishnan, (2010). "Life Skills Training for Positive Behaviour", Rajiv Gandhi National Institute of Youth Development, Tamil Nadu.
- [R4] Dahama O.P., Bhatnagar O.P, (2005). "Education and Communication for Development, (2nd Ed.)", Oxford& IBH Publishing Co. Pvt. Ltd. New Delhi



**PERSONALITY DEVELOPMENT & BEHAVIOURAL SCIENCE**  
**(General Elective-I)**

**Paper Code: ETVHS-517**

**Paper: Personality Development & Behavioural Science**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>2</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objectives and Pre-requisites:** Students should have studied subjects such as General languages, social studies and Moral education at school level. The objective of this subject is to prepare the students to become a good citizen and a professional useful to the society.*

***Learning Outcomes:** The knowledge of this subject will give the student a value system which will help him in taking decisions in professional and social life for the benefit of society at large.*

**UNIT-I**

Definition and Basics of Personality, Understanding Traits and Types of Personality, Analyzing strength and weakness (SW), Body Language

[T1, T2][No. of Hrs. 07]

**UNIT-II**

Business Etiquettes and Public Speaking: Business Manners. Body Language Gestures, Email and Net Etiquettes, Etiquette of the Written Word, Etiquettes on the Telephone, Handling Business Meetings; Introducing Characteristic, Model Speeches, Role Play on Selected Topics with Case Analysis and Real Life Experiences.

[T1, T2][No. of Hrs. 08]

**UNIT-III**

How to Make a Presentation, the Various Presentation Tools, along with Guidelines of Effective Presentation, Boredom Factors in Presentation and How to Overcome them, Interactive Presentation & Presentation as Part of a Job Interview, Art of Effective Listening.

Resume Writing Skills, Guidelines for a Good Resume, How to Face an Interview Board, Proper Body Posture, Importance of Gestures and Steps to Succeed in Interviews. Practice Mock Interview in Classrooms with Presentations on Self; Self Introduction – Highlighting Positive and Negative Traits and Dealing with People with Face to Face.

[T1, T2][No. of Hrs. 08]

**UNIT-IV**

Coping Management, Working on Attitudes: Aggressive, Assertive and Submissive Coping with Emotions, Coping with Stress

[T1, T2][No. of Hrs. 07]

**Text Book(s):**

- [T1] McGraw, S. J., (2008), “Basic Managerial Skills for All, Eighth Edition”, Prentice Hall of India.  
[T2] The Results-Driven Manager (2005). Business Etiquette for the New Workplace: The Results-Driven Manager Series (Harvard Results Driven Manager)

**Reference Book(s):**

- [R1] Pease, A. & Pease, B. (2006)., “The Definitive Book of Body Language”, Bantam Book(s).  
[R2] Scannell, E. & Rickenbacher, C. (2010)., “The Big Book of People Skills Games: Quick, Effective Activities for Making Great Impressions, Boosting Problem-Solving Skills and Improving Customer Service”, Mcgraw Hill Education

**APPLIED MATHEMATICS LAB**  
**(Open Elective-I)**

**Paper Code: ETVAS-557**  
**Paper: Applied Mathematics Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>3</b>

**Note:-** *The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.*

**List of Experiments:**

1. Curve fitting using Method of Least squares.
2. Solution of algebraic and transcendental equation using Gauss- Seidal's iteration method.
3. Solution of algebraic and transcendental equation using Finite difference method.
4. Numerical integration using Trapezoidal Rule & Simpson's one third rule.
5. Solution of ordinary differential equations using Runge-Kutta method.
6. Calculation of probability using probability distributions.
7. Calculation of correlation coefficient.
8. Calculation of Numerical measures such as mean, variance, Skewness & Kurtosis.
9. Estimation of mean & variance using sampling & Hypothesis.
10. Calculation of Rank Correlation.
11. Analysis os samples using ANOVA.

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**DATA ANALYSIS AND DISCRETE MATHEMATICS LAB**  
**(Open Elective-I)**

**Paper Code: ETVCS-553**

**Paper: Data Analysis and Discrete Mathematics Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>3</b>

**Note:-** *The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.*

**List of Experiments:**

**[Following lab experiments will be conducted using SPSS/ Weka/ Rapidminer]**

1. Illustration of Simple Linear Regression Analysis
2. Illustration of Multiple Linear Regression Model
3. Illustration of Multicollinearity
4. Illustration of Variable Selection and Model Building
5. Illustration of Logistic Regression Models
6. Discussion on the applicability of different graph-theoretic algorithm using three-four case studies (Theoretical)
7. Discussion on proof techniques using three-four illustrative examples

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**APTITUDE & LOGICAL REASONING LAB**  
**(Open Elective-I)**

**Paper Code: ETVAS-555**

**Paper: Aptitude & Logical Reasoning Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>3</b>

**Note:-** *The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.*

**List of Experiments:**

Subject teacher has to perform at least eight experiments based on the topic mentioned in the theory paper by using software packages.



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**APPLIED MECHANICS LAB**  
**(Open Elective-I)**

**Paper Code: ETVME-551**  
**Paper: Applied Mechanics Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>3</b>

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

1. Verification of the laws of polygon of forces.
2. To verify the forces in the different members of a jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find out centre of gravity of regular and irregular laminas.
5. To verify the principle of moments using the bell crank lever apparatus
6. To determine the coefficient of static friction between two surfaces
7. To find moment of inertia of a flywheel
8. To find the mechanical advantage, velocity ratio and efficiency in the case of inclined planes.
9. To find the mechanical advantage, velocity ratio and efficiency in the case of Screw Jack
10. To find the mechanical advantage, velocity ratio and efficiency in the case of worm and worm wheel
11. To find the mechanical advantage, velocity ratio and efficiency in the case of single winch Crab.
12. Graphical solutions for the following problems a. Resultant of Coplanar Non Concurrent force system: i. One problem with resultant as a force  
ii. One problem with resultant as a couple b. Equilibrium of Coplanar Non Concurrent force system: one Problem c. Friction: One Problem

**INSTRUCTIONAL STRATEGY**

This is a gateway subject to remaining course. While imparting theoretical instructions, teachers are expected to demonstrate the various apparatus and related concepts to the students by correlating theory and practical. It is further recommended that more emphasis should be laid in conducting practical work by individual students.

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**ENGINEERING GRAPHICS LAB**

**Paper Code: ETVRA-551**  
**Paper: Engineering Graphics Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>3</b>

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:****UNIT-I**

**General:** Importance, Significance and scope of engineering drawing, Lettering, Dimensioning, Scales, Sense of proportioning, Different types of projections, Orthographic Projection, B.I.S. Specifications,

**Projections of Point and Lines:** Introduction of planes of projection, Reference and auxiliary planes, projections of points and Lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on Auxiliary planes, shortest distance, intersecting and non-intersecting lines.

[T1][No. of Hrs. 11]

**UNIT-II**

**Planes other than the Reference Planes:** Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., Projections of points and lines lying in the planes, conversion of oblique plane into auxiliary Plane and solution of related problems.

**Projections of Plane Figures:** Different cases of plane figures (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one of both reference planes). Obtaining true shape of the plane figure by projection.

[T1][No. of Hrs. 12]

**UNIT-III**

**Projection of Solids:** Simple cases when solid are placed in different positions, Axis faces and lines lying in the faces of the solid making given angles.

**CAD (Computer Aided Drawing)**

[T1][No. of Hrs. 11]

**UNIT-IV**

**Isometric Projection**

**Nomography:** Basic Concepts and use.

[T1][No. of Hrs. 11]

**Text Book(s):**

[T1] Engineering Drawing by N.D.Bhatt (Charotar Publications)

**Reference Book(s):**

[R1] Engineering Drawing by S.C.Sharma & Navin Kumar (Galgotia Publications)

[R2] Engineering Drawing by Venugopalan.

[R3] Engineering Drawing by P.S.Gill

**REFRIGERATION-I LAB**

**Paper Code: ETVRA-553**  
**Paper: Refrigeration-I Lab**

L	T/P	C
0	4	4

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

1. Study of refrigerator.
2. Calculation of COP of refrigerator.
3. Study of various components of refrigerator.
4. Charging of refrigerant.
5. Study of various accessories.
6. Study of various tools used in refrigeration Lab.
7. Study of various types of Refrigerants
8. Study of domestic refrigerator.



**GURU GOBIND SINGH  
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**BASIC PROGRAMMING LAB**  
**(Common to all Disciplines except MC, SD, PT, CT)**

**Paper Code: ETVCS-559**  
**Paper: Basic Programming Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>2</b>	<b>2</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objectives:** In order to enable the student's use of computer effectively in problem solving, this course offers the model programming language along with exposure to various application of computer. The knowledge of C language will be reinforced by the practical exercises.*

***Pre-requisites:** Basic understanding about using Computers, using computers.*

**UNIT-I**

Introduction of "C" language- Structure of a "C" program, some simple "C" programs, procedure to execute a "C" program. Data type, constants and variables Character sets, Identifiers and keywords, Date type constants, variables, expression, statement, symbolic constants. Operators and expressions, Arithmetic operators, Relational and logical operators, Unary Operators, Assignment operators, Conditional operators.

**[T1, T2][No. of Hrs. 08]**

**UNIT-II**

Data Input and output, Library functions, unformatted input output-getchar, putchar, gets, puts, getch and getche. Formatted input output-Scanf, printf, Control statements and loop structure,

**Branching:** The if-else statement,

**Looping:** while, do-while for. Nested control structure. Switch statement. Break. Continue, exit. Comma operator.

**Jumping:** go to statement,

**Function:** Inductions to function, need of functions, function definition, function declaration and prototype, passing arguments to function. Passing arguments by value, recursion, Arrays-Introduction to Arrays. array declaration, single and multidimensional array Examples: array order reversal, removal of duplicates from an ordered array, binary search, matrix multiplication.

**[T1, T2][No. of Hrs. 08]**

**UNIT-III**

**Strings:** Introduction to strings, string constants, variables, input, output of string date, standard library string function strlen (), strcat () strepy () strcmp (),Pointers-Introduction to pointers, address operator and indirection operator, declaring and initialize pointers, pointers in parameter passing, call by reference, pointers and one dimensional array, operation on pointers and one dimensional arrays, dynamic memory location malloc, calloc, structure and unions-Introduction to structure, declaration of structure, accessing structure, members initialization Arrays of structure, user defined data type (typedef), Introduction to unions.

**[T1, T2][No. of Hrs. 08]**

**UNIT-IV**

Files-Introduction to file handling-fopen, fclose, fscanf, fprintf,getc, putc Additional feature of c: Enumerations, macro, c pre-processor.

**[T1, T2][No. of Hrs. 06]**

**Text Book(s):**

- [T1] Byron C. Gottfried, "Programming with C", McGraw-Hill Education
- [T2] Yashwant Kanetkar, "Let us C", Infinity Science Press, 2008
- [T3] Moolish Cooper, "Sprit of C", Jaico Publishing House
- [T4] Herbert Schildt, "Teach yourself C", Tata Mc Graw hill

**Reference Book(s):**

- [R1] Stephen G. Kochan, "Programming in C", Pearson Education
- [R2] Kerning & Ritchie, "C Programming Language", Prentice Hall; 2<sup>nd</sup> Edition
- [R3] Balaguruswamy, "Ansi C", Tata Mc Graw Hill



**List of Experiments:**

1. Programming exercises on executing and editing c programs.
2. Programming exercises on defining variables and assigning values to variables.
3. Programming exercises on arithmetical, relational operators.
4. Programming exercises on arithmetic expression and their evaluation.
5. Programming exercises on formatting input/out using printf and scanf.
6. Programming exercises using if-statement.
7. Programming exercises using if-else statement.
8. Programming exercises on switch statement.
9. Programming exercises on do-while statement.
10. Programming exercises on for statement.
11. Programs on 1 dimensional array.
12. Programs on 2 dimensional arrays.
13. Programs on strings (Copying, Concatenation, Compare, Character frequency, string Length Count etc).
14. Simple programs using pointers.
15. Simple programs using structures.
16. Simple programs using files.



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**VOCATIONAL WORKSHOP-I (MECHANICAL)**

<b>Paper Code: ETVRA-559</b>	<b>L</b>	<b>T/P</b>	<b>C</b>
<b>Paper: Vocational Workshop-I (Mechanical)</b>	<b>0</b>	<b>4</b>	<b>4</b>

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:****UNIT-I**

**Materials:** Spectrography method for finding composition of materials.

**Wood Working Shop:** Making of various joints, Pattern making.

**Foundary Shop:** Bench moulding with single piece pattern and two piece pattern.

Floor moulding – Making of bend pipe mould etc.

Machine moulding – Making of mould using Match-plate pattern.

Core making- Making and baking of dry sand cores for placing in horizontal, vertical and hanging positions in the mould cavity.

[No. of Hrs. 11]

**UNIT-II**

**Fitting Shop:** Learning use of fitting hand tools, marking tools, marking gauge.

Exercises: Jobs made out of MS Flats, making saw – cut filling V-cut taper at the corners, circular cut, fitting square in square, triangle in square.

**Introduction to machine tools-** Lathe machine, drilling machine, Power hexa.

[No. of Hrs. 11]

**UNIT-III**

**Welding Shop:** Electric arc welding, Edge preparations, Exercises making of various joints. Bead formation in horizontal, vertical and overhead positions.

**Gas Welding:** Oxy-Acetylene welding and cutting of ferrous metals.

**Soldering:** Dip soldering.

**Brazing:** With Oxy-Acetylene gas.

[No. of Hrs. 11]

**UNIT-IV**

**Sheet Metal Shop:** Learning use of sheet-metal tools, Exercises: Making jobs out of GI sheet metal. Cylindrical, Conical and Prismatic shapes.

**Project Shop:** Extrusion of soft metals, Plastic coating of copper wires, Plastic moulding

**Introduction to plumbing-** study of plumbing tools and different joints.

[No. of Hrs. 12]

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**THERMAL ENGINEERING**

**Paper Code: ETVRA-502**  
**Paper: Thermal Engineering**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:****MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objectives and Pre-requisites: To provide exposure to the students in respects of the basics of different aspects of Thermal engineering with emphasis on various concepts.*

**UNIT I****Formation of Steam and Its Properties**

Steam formation at constant pressure, wet steam, dry steam & saturated steam. Dryness fraction. Sensible heat, latent heat, total heat, internal energy, specific volume. Expansion of vapour according to various thermodynamic processes. Use of steam table. Entropy of water, wet, dry and super heated steam. Use of temperature Entropy charts.

**[T1,T2][No. of Hrs. 11]****UNIT-II****Steam Boilers**

Uses of steam. Classification of Boilers. Comparison of fire tube and water tube boilers. Constructional feature of Lancashire, Cochran, Babcock and Wilcox boilers. Boiler mountings. Boiler accessories- Economiser, super heater. Introduction to fuel for Boilers. Performance of Boilers – Equivalent evaporation, Boiler efficiency.

**[T1,T2][No. of Hrs. 11]****UNIT-III****Steam Condensers**

Function, working principle, classification and description of surface condensers. Cooling towers and cooling ponds. Sources of air in condensers. Calculation for cooling water in condensers

**[T1,T2][No. of Hrs. 11]****UNIT-IV****Internal Combustion Engines**

**Classification** - Components and their function

Valve timing diagram and port timing diagram Comparison of two stroke and four stroke engines - Carburettor system, Diesel pump and injector system.

Performance calculation - Comparison of petrol and diesel engine - Lubrication system and Cooling system

Battery and Magneto Ignition System – Formation of exhaust emission in SI and CI engines

**Steam Nozzles and Turbines:**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow

**[T1,T2][No. of Hrs. 12]****Text Book(s):**

[T1] Sarkar, B.K., "Thermal Engineering" Tata McGraw-Hill Publishers, 2007

[T2] Kothandaraman C.P., Domkundwar. S, Domkundwar. A.V., "A Course in Thermal Engineering," Dhanpat Rai & sons, Fifth edition, 2002

**Reference Book(s)**

[R1] Rajput. R. K., "Thermal Engineering", S.Chand Publishers, 2000

[R2] Arora.C.P., "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers 1994

[R3] Ganesan V, "Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2007

[R4] Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003

**AIR-CONDITIONING-I**

**Paper Code: ETVRA-504**  
**Paper: Air-Conditioning-I**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:****MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objectives and Pre-requisites:** To provide exposure to the students in respects of the basics of different aspects of Air conditioning engineering with emphasis on various concepts.*

**UNIT - I**

**Introduction:** Definition of air conditioning, metabolism in human body, human comfort, application of air conditioning.

**[T1,T2][No. of Hrs. 11]****UNIT - II**

**Psychrometry:** Psychrometric properties of air – Dry bulb temperature, wet bulb temperature, dew point temperature, specific humidity, relative humidity.

Psychrometric chart and its uses.

Psychrometric processes – sensible heating and sensible cooling, humidification and dehumidification, cooling and humidification, heating and humidification, cooling and dehumidification, heating and dehumidification, mixing of two different streams of air.

**[T1,T2][No. of Hrs. 11]****UNIT - III**

**Load estimation:** Various types of heat loads – sensible & latent heat loads, heat load calculations.

**Air conditioning systems:** Room air conditioners, central air conditioning system, round the year air conditioning system.

**[T1,T2][No. of Hrs. 11]****UNIT-V:**

**Air distribution system:** concept of filter, damper, fan, blower, air register and diffuser. Heating system: Hot water heating system, heating system using strip heaters.

**[T1,T2][No. of Hrs. 12]****Text Book(s):**

[T1] P.L.Ballaney, Refrigeration & Air conditioning, Khanna Publisher

[T2] C.P Arora, Refrigeration & Air conditioning, Tata Mc Graw Hill

**Reference Book(s):**

[R1] Pita, Air conditioning Principles & Systems, Prentice Hall of India Pvt. Ltd.

[R2] Jones, Air conditioning, Tata Mc Graw Hill

**ENVIRONMENTAL SCIENCE**  
**(Common To All Disciplines)**

**Paper Code: ETVEN-502**  
**Paper: Environmental Science**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective:** The objective of this course is to make students environment conscious. They will be exposed through the fundamental concepts of environment and ecosystem so that they can appreciate the importance of individual and collective efforts to preserve and protect our environment. This course must raise various questions in student's mind that how our environment is inter dependent on various factors and how human being must care for their natural surroundings.*

**UNIT-I**

**Environmental Studies: Ecosystems, Bio-diversity and its Conservation**

***(i) The Multidisciplinary Nature of Environmental Studies***

Definition, scope and importance of Environmental Studies, Biotic and a biotic component of environment, need for environmental awareness.

***(ii) Ecosystems***

Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and function of the following ecosystem:

- (a) Forest ecosystem
- (b) Grassland ecosystem
- (c) Desert ecosystem
- (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).

***(iii) Bio-diversity and its Conservation***

Introduction to biodiversity - definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity : Habitat loss, Poaching of wildlife, man-wildlife conflicts, rare endangered and threatened species (RET) endemic species of India, method of biodiversity conservation: *In-situ* and *ex-situ* conservation.

**[T1], [R3] [No. of hrs. 11]**

**UNIT-II**

**Natural Resources: problems and prospects**

Renewable and Non-renewable Natural Resources; Concept and definition of Natural Resources and need for their management

- *Forest resources:* Use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forests and tribal people.
- *Water resources:* Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, Water conservation, rain water harvesting, watershed management.
- *Mineral resources:* Uses are exploitation, environmental effects of extracting and using mineral resources, case studies.
- *Food resources:* World food problems, changes causes by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- *Energy resources:* Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Urban problems related to energy, case studies.
- *Land resources:* Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

**[T1], [R3] [No. of hrs. 11]**

**UNIT-III****Environmental Chemistry and Pollution Control****(i) Chemistry of Environment**

(a) *Green Technology*: Principles of Green technology, Zero Waste Technology, Green Chemistry & Its basic principles, Atom Economy, Green Methodologies, clean development mechanisms (CDM), concept of environmental impact assessment,

(b) *Eco-Friendly polymers*: Environmental degradation of polymers, Biodegradable, Photo-biodegradable polymers, Hydrolysis & Hydrobiodegradable, Biopolymers & Bioplastics: polylactic acid, polyhydroxybutyrate, polycaprolactone,. Concept of bioremediation.

**(ii) Environmental Pollution**

Definition, types, causes, effects and control measures of (a) Air pollution, (b) Water pollution, (c) Soil pollution, (d) Marine pollution, (e) Noise pollution, (f) Thermal pollution, (g) Nuclear hazards. Pollution case studies. Solid waste and its management: causes, effects and control measures of urban and industrial waste.

**Chemical toxicology**-Terms related to toxicity, impact of chemicals (Hg, As, Cd, Cr, Pb) on environment.

[T1], [R3] [No. of hrs. 11]

**UNIT-IV****Disaster Management, Social Issues, Human Population and the Environment****(i) Disaster Management**

Disaster management: floods, earthquake, cyclone and land-slides, nuclear accidents and holocaust, *case studies*.

**(ii) Social Issues, Human Population and the Environment**

Sustainable development, Climate change, global warming, acid rain, ozone layer depletion, Environmental ethics: Issues and possible solutions, Consumerism and waste products, Wasteland reclamation. Population growth, problems of urbanization, Environment Protection Act, 1986; Air (Prevention and Control of Pollution) Act, 1981; Water (Prevention and

Control of Pollution) Act, 1974; Wildlife Protection Act, 1972; Forest Conservation Act, 1980; Environmental management, system standards-ISO 14000 series.

[T1] [No. of hrs. 12]

**Text Book(s):**

[T1] E. Barucha, Textbook of Environmental Studies for Undergraduate Courses, Universities Press (India) Pvt. Ltd., 2005.

[T2] S. Chawla, A Textbook of Environmental Studies, McGraw Hill Education Private Limited, 2012

**References Book(s):**

[R1] G. T. Miller, Environmental Science, Thomas Learning, 2012

[R2] W. Cunningham and M. A. Cunningham, Principles of Environment Science: Enquiry and Applications, Tata McGraw Hill Publication, N. Delhi, 2003.

[R3] R. Rajagopalan, Environmental Studies: From Crisis to Cure, 2<sup>nd</sup> Edition, Oxford University Press, 2011.

[R4] A.K. De, Environmental Chemistry, New Age Int. Publ. 2012,.

[R5] A. Kaushik and C.P. Kaushik, Perspectives in Environment Studies, 4<sup>th</sup> Edition, New Age International Publishers, 2013

[R6] Environmental Engineering by Gerard Kiely, Tata McGraw-Hill Publishing Company Ltd. New Delhi, 2010.

**APPLIED PHYSICS**  
**(Open Elective-II)**

**Paper Code: ETVAS-502**  
**Paper: Applied Physics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective:** The objective of the paper is to facilitate the student with the basic understanding of Applied Physics aspects that are required for his understanding of electronics and Electromagnetics.*

**UNIT-I**

**Interference:** Introduction, Interference due to division of wave front: Fresnel's Biprism, Interference due to division of amplitude: wedge shaped film, Newton's rings.

**Diffraction:** Introduction, Difference between Fresnel and Fraunhofer diffraction, Single slit diffraction, Transmission diffraction grating, Absent spectra.

[T1][T2][No. of Hrs. 11]

**UNIT-II**

**Polarization:** Introduction, Uniaxial crystals, Double refraction, Nicol prism, Quarter and half wave plates, Theory of production of plane, circularly and elliptically polarized lights, Specific rotation, Laurents half shade polarimeter.

[T1][T2][No. of Hrs. 11]

**UNIT-III**

**Electromagnetic Theory:** Gradient, Divergence, Curl, Gauss' law, Ampere's Law, Continuity equation, Maxwell's equations (differential and integral forms), Significance of Maxwell's equations, Poynting Theorem, Electromagnetic wave propagation in dielectrics and conductors.

[T1][T2][No. of Hrs. 11]

**UNIT-IV**

**Band Theory of Solids:** Introduction, Kronig-Penney model: E-k diagram, Effective mass of an electron, Intrinsic semiconductors: Electron concentration in conduction band, Hole concentration in valence band, Extrinsic semiconductor: p-type and n-type semiconductors, Fermi level, Hall Effect: Hall voltage and Hall coefficient.

[T1][T2][No. of Hrs. 12]

**Text Book(s):**

[T1] Arthur Beiser, 'Concepts of Modern Physics', [McGraw-Hill], 6<sup>th</sup> Edition 2009

[T2] A. S. Vasudeva, 'Modern Engineering Physics', S. Chand, 6<sup>th</sup> Edition, 2013.

**Reference Book(s):**

[R1] A. Ghatak 'Optics', TMH, 5<sup>th</sup> Edition, 2013

[R2] G. Aruldas 'Engineering Physics' PHI 1<sup>st</sup> Edition, 2010.

[R3] Feynman "The Feynman lectures on Physics Pearson Volume 3 Millennium Edition, 2013

[R4] Uma Mukhrji 'Engineering Physics' Narosa, 3<sup>rd</sup> Edition, 2010.

[R5] H.K. Malik & A. K. Singh 'Engineering Physics' [McGraw-Hill], 1<sup>st</sup> Edition, 2009.

**DIGITAL ELECTRONICS**  
**(Open Elective-II)**

**Paper Code: ETVEC-504**  
**Paper: Digital Electronics**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objective: The objective of the paper is to facilitate the student with the knowledge of Logic Systems and Circuits, thereby enabling the student to obtain the platform for studying Digital Systems and Computer Architecture.*

**UNIT- I**

**Number Systems and Codes:-** Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.

**Switching Theory: -** Boolean Algebra- Postulates and Theorems, De' Morgan's Theorem, Switching Functions- Canonical Forms- Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods.

**Combinational Logic Circuits:-** Review of basic gates- Universal gates, Adder, Subtractor, Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL.

[T2, T3][No. of Hrs. 11]

**UNIT- II**

**Integrated circuits: -** TTL and CMOS logic families and their characteristics. Brief introduction to RAM and ROM.

**Sequential Logic Circuits: -** Latches and Flip Flops- SR, D, T and MS-JK Flip Flops, Asynchronous Inputs.

**Counters and Shift Registers:-** Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters, Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and Johnson Counter.

[T2, T3][No. of Hrs. 11]

**UNIT- III**

**Synchronous Sequential Circuits: -** State Tables State Equations and State Diagrams, State Reduction and State Assignment, Design of Clocked Sequential Circuits using State Equations.

**Finite state machine-**capabilities and limitations, Mealy and Moore models-minimization of completely specified and incompletely specified sequential machines, Partition techniques and merger chart methods-concept of minimal cover table.

[T1][No. of Hrs. 11]

**UNIT- IV**

**Algorithmic State Machine:** Representation of sequential circuits using ASM charts synthesis of output and next state functions, Data path control path partition-based design.

**Fault Detection and Location:** Fault models for combinational and sequential circuits, Fault detection in combinational circuits; Homing experiments, distinguishing experiments, machine identification and fault detection experiments in sequential circuits.

[T1][No. of Hrs. 12]

**Text Book:**

- [T1] Zyi Kohavi, "Switching & Finite Automata Theory", TMH, 2<sup>nd</sup> Edition
- [T2] Morris Mano, "Digital Logic and Computer Design", Pearson
- [T3] R.P. Jain, "Modern Digital Electronics", TMH, 2<sup>nd</sup> Ed,

**Reference Book(s):**

- [R1] A Anand Kumar, "Fundamentals of Digital Logic Circuits", PHI
- [R2] Taub, Helbert and Schilling, "Digital Integrated Electronics", TMH



**BASICS OF ELECTRICAL ENGINEERING**  
**(Open Elective-II)**

**Paper Code: ETVEE-508**

**Paper: Basics of Electrical Engineering**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective:** To provide exposure to the students in respects of the basics of different aspects of electrical engineering with emphasis on constructional, measurement and applications of various types of instruments and equipments.*

**UNIT – I: DC Circuits**

Introduction of Circuit parameters and energy sources (Dependent and Independent), Mesh and Nodal Analysis, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer and Millman's Theorems, Star-Delta Transformation and their Applications to the Analysis of DC circuits.

[T1],[T2][No. of Hrs. 11]

**UNIT – II: A.C. Circuits**

A.C. Fundamentals, Phasor representation, Steady State Response of Series and Parallel R-L, R-C and R-L-C circuits using j-notation, Series and Parallel resonance of RLC Circuits, Quality factor, Bandwidth, Complex Power, Introduction to balanced 3-phase circuits with Star- Delta Connections.

[T1],[T2][No. of Hrs. 11]

**UNIT – III: Measuring Instruments**

Basics of measuring instruments and their types ,Working principles and applications of moving coil, moving iron (ammeter & voltmeter) and Extension of their ranges, dynamometer- type Wattmeter , induction-type Energy Meter , Two-wattmeter method for the measurement of power in three phase circuits, Introduction to digital voltmeter, digital Multimeter and Electronic Energy Meter.

[T1],[T2],[R2][No. of Hrs. 11]

**UNIT – IV: Transformer and Rotating Machines**

Fundamentals of Magnetic Circuits, Hysteresis and Eddy current losses, working principle, equivalent circuit, efficiency and voltage regulation of single phase transformer and its applications. Introduction to DC and Induction motors (both three phase and single phase), Stepper Motor and Permanent Magnet Brushless DC Motor.

[T1],[T2],[R2][No. of Hrs. 12]

**Text Book(s):**

[T1] S.N Singh, "Basic Electrical Engineering" PHI India Ed 2012

[T2] Chakrabarti, Chanda,Nath "Basic Electrical Engineering" TMH India", Ed 2012.

**Reference Book(s):**

[R1] William Hayt "Engineering Circuit Analysis" TMH India Ed 2012

[R2] Giorgio Rizzoni "Principles and Application of Electrical Engineering" Fifth Edition TMH India.

**ENGINEERING MATERIALS**  
**(Open Elective-II)**

**Paper Code: ETVME-510**  
**Paper: Engineering Materials**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>3</b>

**INSTRUCTIONS TO PAPER SETTERS:**

**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

**Objectives and Pre-requisites:** To acquire proper knowledge about different construction materials and their applications. To have exposure about various construction materials as required in engineering. The students should learn the details of various construction materials such as stones, bricks and tiles, cement and cement based products, and lime, timber and wood based products, paint and varnishes metals and other miscellaneous materials and their applications.

**Learning outcomes:** Helps in making him as a better super visor at construction sites/ industries. Improved ability to identify and visualize various construction materials that are being used in construction and other industries. Enhanced knowledge of construction materials helps students in pursuing their careers in material testing field. This subject helps in understanding the various subjects related to different vocational courses in later stages.

**UNIT-I:**

**Building Stones:** Classification of Rocks, Geological classification: Igneous, sedimentary and metamorphic rocks. Chemical classification: Calcareous, argillaceous and siliceous rocks. Physical classification: Un-stratified, stratified and foliated rocks; Requirements of good building stones, testing & identification of common building stones and their uses. Bricks and Tiles: Introduction to bricks, Raw materials for brick manufacturing and properties of good brick making earth, Classification of bricks as per IS: 1077, Testing of common building bricks as per IS: 3495. Compressive strength, water absorption, efflorescence test, Dimensional tolerance test. Types and use of- tiles for wall, roofing & flooring; ceramic tiles; Hollow masonry blocks; Fly ash bricks.

[T1, T2][No. of Hrs: 11]

**UNIT-II:**

**Cement:** Introduction, raw materials, manufacturing of ordinary Portland cement, flow diagram for wet and dry process. Properties and uses of ordinary Portland cement. Special cements and their uses. Storage of cement. **Lime:-**Introduction: Lime as one of the cementing materials. Definition of terms; quick lime, fat lime, hydraulic lime, hydrated lime, lump lime. Calcinations and slaking of lime IS classification of lime. Definition- Properties and uses of Mortar. Types of mortar, cement & lime Mortar, Preparation of cement Mortar.

[T1, T2][No. of Hrs: 11]

**UNIT III:**

Timber and wood based products. Identification of different types of timber: Teak, Deodar, Shisham, Sal, Mango. Market forms of converted timber as per IS. Seasoning of timber: purpose, methods of seasoning. Defects and decay in timber, Preservation of timber and methods of treatment, Properties and specifications of structural timber. Other wood based products, their brief description of manufacture and uses: Lamina board, Black board, fiber board. Hard board and gypsum board.

[T1, T2][No. of Hrs: 11]

**UNIT IV:**

Purpose and use of paints, Types, ingredients, properties and uses of oil paints, water paints and Cement paints. Types, properties and uses of varnishes, Trade name of different products. Metals: - uses of ferrous and non-ferrous metals, Commercial forms of ferrous and non-ferrous metals. Plastics – Introduction and uses of various plastic products in buildings such as doors, water tanks and PVC pipes. Types uses and application of- Fiber Sheets, insulating materials, Materials used in interior decoration works like POP, Water proofing compounds, fire resisting materials.

[T1, T2][No. of Hrs: 12]

**Text Book(s):**

- [T1] Surendra Singh; “Engineering Materials; “New Delhi”. Vikas Publishing House Pvt. Ltd.  
[T2] TTTI, Chandigarh “Civil Engineering Materials; “Tata McGraw Hill.

**Reference Book(s):**

- [R1] M.L.Gambhir and Neha Jamwal, “Building Materials”, Tata McGraw Hill.  
[R2] Building Materials, P.C.Varghese, PHI Publications  
[R3] Engineering materials S.C. Rangwala, Charotar Publishing House  
[R4] Building Materials, Duggal, New Age Publication  
[R5] Kulkarni, GJ; “Engineering Materials; “Ahmedabad, Ahmedabad Book Depot.



**APPLIED PHYSICS LAB**  
**(Open Elective-II)**

**Paper Code: ETVPH-552**  
**Paper: Applied Physics Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>2</b>	<b>2</b>

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

**Instructions:** Twelve Experiments are to be chosen from the list given below and rest of the Experiments (i.e., three in number) may be designed by the faculty at the respective institute according to the Syllabus being taught.

1. To determine the wavelength of sodium light by Newton's Rings.
2. To determine the wavelength of sodium light by Fresnel's biprism.
3. To determine the wavelength of sodium light using diffraction grating.
4. To measure small thickness of a piece of paper using Newton's Rings technique.
5. To determine the refractive index of a prism using spectrometer.
6. To determine the dispersive power of prism using spectrometer and mercury source.
7. To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
8. To find the wavelength of He-Ne laser using transmission diffraction grating.
9. To determine the numeral aperture (NA) of an optical fibre.
10. To determine the e/m ratio of an electron by J.J. Thomson method.
11. To measure time period of a waveform and calculate its frequency and wavelength using CRO.
12. To measure the frequency of a sine-wave voltage obtained from signal generator and to obtain lissajous pattern on the CRO screen by feeding two sine wave signals from two signal generators.
13. To determine the frequency of A.C. mains by using Sonometer .
14. To determine the frequency of electrically maintained tuning fork by Melde's method.
15. Computer simulation (simple application of Monte Carlo): Brownian motion, charging & discharging of a capacitor.
16. To study the charging and discharging of a capacitor and to find out the time constant.
17. To study the Hall effect.
18. To determine the energy band gap of a semiconductor by four probe method/or by measuring the variation of reverse saturation current with temperature.
19. To study the V-I characteristics of Zener diode.
20. To measure surface tension of different liquids using capillary rise method.
21. To measure coefficient of viscosity by Stoke's method.

**Text Book(s):**

[T1] C. L. Arora 'B. Sc. Practical Physics' S. Chand

**DIGITAL ELECTRONICS LAB**  
**(Open Elective-II)**

**Paper Code: ETVEC-554**  
**Paper: Digital Electronics Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>2</b>	<b>2</b>

**Note:-** *The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.*

**List of Experiments:**

1. Realize all gates using NAND & NOR gates
2. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
3. Realize a BCD adder
4. Realize a Serial Adder
5. Realize a four bit ALU
6. Realize Master-Slave J K Flip-Flop, using NAND/NOR gates
7. Realize Universal Shift Register
8. Realize Self-Starting, Self Correcting Ring Counter
9. Realize Multiplexer and De-Multiplexer
10. Realize Carry Look ahead Adder / Priority Encoder
11. Simulation of PAL and PLA
12. Simulation Mealy and Moore State machines

**GURU GOBIND SINGH  
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 UNIVERSITY**

**BASICS OF ELECTRICAL ENGINEERING LAB**  
**(Open Elective-II)**

**Paper Code: ETVEE-558**

**Paper: Basics of Electrical Engineering**

L	T/P	C
0	2	2

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

1. To Design the circuit for a given load and selection of its various Components and instruments from the safety point of view
2. Study and applications of CRO for measurement of voltage, frequency and phase of signals.
3. Connection of lamp by  
(1)Single Switch Method.(2) Two-way Switch Method.  
OR  
Performance comparison of of fluorescent Tube & CFL Lamp.
4. To Verify Thevenin's & Norton's Theorem  
OR  
To Verify Superposition &Reciprocity Theorem.  
OR  
To Verify Maximum Power Transfer Theorem.
5. To Measure Power & Power Factor in a Single-Phase A.C Circuit using Three Ammeters or three Voltmeters.
6. To Measure Power & Power Factor in a Balanced Three Phase Circuit using Two Single Phase Wattmeters.
7. To study of Resonance in a series R-L-C or Parallel R-L-C Circuits.
8. To perform open circuit and short circuit test on 1-phase transformer.
9. Starting, Reversing and speed control of DC shunt Motor
10. Starting, Reversing and speed control of 3-phase Induction Motor
11. To Study different types of Storage Batteries & its charging system.
12. .To Study different types of earthing methods including earth leakage circuit breaker (GFCI)

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**ENGINEERING MATERIALS LAB**  
**(Open Elective-II)**

**Paper Code: ETVME-560**  
**Paper: Engineering Materials Lab**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>2</b>	<b>2</b>

**Note:-** *The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.*

**List of Experiments:**

- 1) To determine the crushing strength of bricks
- 2) To determine the water absorption of bricks.
- 3) To conduct field tests on cement.
- 4) To determine fineness (by sieve method) of cement.
- 5) To determine normal consistency of cement.
- 6) To determine initial and final setting times of cement.
- 7) To determine soundness of cement.
- 8) To determine compressive strength of cement.
- 9) Field visit to study different types of cements that are used in construction industry
- 10) Field visit to study different types of bricks that are used in construction
- 11) Field visit to study use of timber in construction
- 12) A report on use of plastic materials for various purposes in buildings
- 13) Field visit to study different types of tiles used in construction industry
- 14) Field visit to study different type of paints used in buildings
- 15) A report on new and latest material being used in construction industry.

Teachers are expected to physically show various materials while imparting instructions. Field visits should be organized and active participation of students shall be encouraged.

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**THERMAL ENGINEERING LAB**

**Paper Code: ETVRA-552**  
**Paper: Thermal Engineering Lab**

L	T/P	C
0	4	4

**Note:-** *The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.*

**List of Experiments:**

1. Study of pressure gauge and water level indicator on a Boiler .
2. Study of stop valve, dead weight safety valve and fusible plug.
3. Study of stop lever and spring loaded safety valve, high steam and low water alarm.
4. Study of blow off cock, feed check valve and feed water pump.
5. Study of Lancashire boiler.
6. Study of super heating and throttling calorimeter.
7. Study of Condenser.
8. Study of Cochran Boiler.



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**AIR-CONDITIONING-I LAB****Paper Code: ETVRA-554****Paper: Air conditioning-I Lab**

L	T/P	C
0	4	4

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

1. Measurement of DBT and WBT using sling psychomotor.
2. Heat load calculation.
3. Calculation of COP of air conditioner.
4. Calculation of COP of air conditioner central A/C plant.
5. Study of fan, blower & diffuser.
6. Study of various types of filters.
7. Study of various types of dampers.
8. Study of room window air conditioner.



**GURU GOBIND SINGH  
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**ENVIRONMENTAL SCIENCE LAB/ FIELD WORK**  
**(Common to All Disciplines)**

<b>Paper Code: ETVEN-552</b>	<b>L</b>	<b>T/P</b>	<b>C</b>
<b>Paper: Environmental Science Lab/ Field Work</b>	<b>0</b>	<b>2</b>	<b>2</b>

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

1. Determination of pH, conductivity and turbidity in drinking water sample.
2. Determination of pH and conductivity of soil/sludge samples.
3. Determination of moisture content of soil sample.
4. Determination of Total Dissolved Solids (TDS) of water sample.
5. Determination of dissolved oxygen (DO) in the water sample.
6. Determination of Biological oxygen demand (BOD) in the water sample.
7. Determination of Chemical oxygen demand (COD) in the water sample.
8. Determination of Residual Chlorine in the water sample.
9. Determination of ammonia in the water sample.
10. Determination of carbon dioxide in the water sample.
11. Determination of nitrate ions or sulphate ions in water using spectrophotometer.
12. Determination of the molecular weight of polystyrene sample using viscometer method.
13. Base catalyzed aldol condensation by Green Methodology.
14. Acetylation of primary amines using eco-friendly method.
15. To determine the concentration of particulate matter in the ambient air using High Volume Sampler.

**P.S.:** For better understanding of various aspects of environment visits to local areas, depending upon easy access and importance may be planned to any nearby river, forest, grassland, hills and students should write a report based on their observations.

**Suggested Book(s):**

- [T1] [A. I. Vogel, G. H. Jeffery](#), *Vogel's Text Book of Quantitative Chemical Analysis*, Published by Longman Scientific & Technical, 5<sup>th</sup> Edition, 1989.
- [T2] [dst.gov.in/green-chem.pdf](http://dst.gov.in/green-chem.pdf) (monograph of green chemistry laboratory experiments).
- [T3] S. Chawla, *Essentials of Experimental Engineering Chemistry*, Dhanpat Rai & Co., 3<sup>rd</sup> Edition, 2008.
- [T4] S. Rattan, *Experiments in Applied Chemistry*, Published by S.K.Kataria & Sons, 2<sup>nd</sup> Edition, 2003.
- [T5] W. Cunningham and M. A. Cunningham, *Principles of Environment Science: Enquiry and Applications*, Tata McGraw Hill Publication, N. Delhi, 2003.
- [T6] A. Kaushik and C. P. Kaushik, *Perspectives in Environment Studies*, 4<sup>th</sup> Edition, New Age International Publishers, 2013.

**VOCATIONAL WORKSHOP-II (RAC)****Paper Code: ETVRA-560****Paper: Vocational Workshop-II (RAC)**

<b>L</b>	<b>T/P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>3</b>

**Note:-** The required list of Experiments is provided as under. The example cited here are purely indicative and not exhaustive. Attempt shall be made to perform all experiments. However, at least 8 experiments should be done in the semester. More experiments may be designed by the respective institutes as per their choice.

**List of Experiments:**

1. To study various tools used in Refrigeration and Air conditioning Lab
2. Copper tube cutting.
3. Copper tube flaring.
4. Copper tube swaging.
5. Copper tube bending.
6. Copper tube brazing.
7. Maintenance of Refrigerator.
8. Maintenance of Air conditioner.
9. Maintenance of water cooler.



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