

STATE BOARD OF TECHNICAL EDUCATION, BIHAR**Scheme of Teaching and Examinations for****Ist Semester****(Effective from Session 2020-21)****THEORY**

Sr. No.	SUBJECTS	SUBJECT CODE	TEACHING SCHEME			EXAMINATION – SCHEME							Credits
			Periods per Week			Hours of Exam.	Teacher's Assessment (TA) Marks (A)	Class Test(CT) Marks (B)	End Semester Exam. (ESE) Marks (C)	Total Marks (A+B+C)	Pass Marks ESE	Pass Marks in the Subject	
			L	T	L+T								
1.	Mathematics-I	2001101	02	01	03	03	10	20	70	100	28	40	03
2.	Applied Physics-I	2001102	02	01	03	03	10	20	70	100	28	40	03
3.	Applied Chemistry	2001103	02	01	03	03	10	20	70	100	28	40	03
4.	Communication Skills in English	2001104	02	-	02	03	10	20	70	100	28	40	02
5.	Engg. Graphics	2001105	03		03	03	10	20	70	100	28	40	02
	Total:-		11	03	14				350	500			13

PRACTICAL

Sr. No.	SUBJECTS	SUBJECT CODE	TEACHING SCHEME	EXAMINATION – SCHEME					Credits
			Periods per Week	Hours of Exam.	Practical		Total Marks	Pass Marks in the Subject	
					Internal(PA)	External(ESE)			
6.	Applied Physics Lab-I	2001106	03	03	15	35	50	20	02
7.	Applied Chemistry Lab	2001107	03	03	15	35	50	20	02
8.	Communication Skills in English Lab	2001108	03	03	15	35	50	20	02
Total:-			09				150		06

TERM WORK

Sr. No.	SUBJECTS	SUBJECT CODE	TEACHING SCHEME	EXAMINATION – SCHEME				Credits
			Periods per week	Marks of Internal (PA)	Marks of External (ESE)	Total Marks	Pass Marks in the Subject	
9.	Engg. Workshop Practice	2001109	06	07	18	25	10	02
10.	Sports and Yoga	2001110	02	07	18	25	10	02
11.	C/KYP/IT Essential / Python/ Others	2001111	-	15	35	50	20	01
Total:-			08			100		05
Total Periods per week Each of duration One Hour 31				Total Marks = 750				24

MATHEMATICS-I

Subject Code 2001101	Theory			No of Periods in One Session : 45			Credits
	No. of Periods Per Week			Full Marks			03
	L	T	P/S	ESE	:	100	
	02	01	-	TA	:	10	
	-	-	-	CT	:	20	

Course Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of Trigonometry, Co-ordinate Geometry, Basic elements of algebra and Matrices.

Course Content:

UNIT - I: Trigonometry

[09]

Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles ($2A$, $3A$, $A/2$). Graphs of $\sin x$, $\cos x$, $\tan x$ and e^x . Concept of inverse circular function.

UNIT - II: Co-Ordinate Geometry

[17]

Equation of straight line in various standard forms (without proof), intersection of two straight lines,

Angle between two lines. Parallel and perpendicular lines, perpendicular distance formula.

General equation of a circle and its characteristics. To find the equation of a circle, given:

- Centre and radius,
- Three points lying on it and
- Coordinates of end points of a diameter;

Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations (without proof). Problems on conics when their foci, directories or vertices are given.

UNIT - III: Algebra

Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and cartesian [04]
representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number. Addition, Subtraction, Multiplication and Division of complex numbers, De-moivre's theorem (without proof) and its application.

Partial fractions: Definition of polynomial fraction, proper & improper fractions and definition [03]
of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors. To resolve improper fraction into partial fraction.

Permutations and Combinations: Definition of Factorial Notation, Introduction of [02]
Permutation & Combination, Value of nP_r and nC_r .

Binomial Theorem: Binomial theorem (without proof) for positive integral index (expansion [04]
and general form); binomial theorem for any index (expansion without proof) first and second

Determinants and Matrices

[06]

Elementary properties of determinants up to 3rd order, consistency of equations, Cramer's rule. Algebra of matrices, Transpose of a matrix, Adjoint of a matrix, Inverse of a matrix, (by adjoint method), matrix inverse method to solve a system of linear equations in 2 or 3 variables.

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
3. Mathematics Today - XI & XII (Part I) by Lalji Prasad (Paramount Publication, Govind Mitra Road).
4. A Text Book of Mathematics-XI & XII (Vol-1) by K.C. Sinha-Rastogi Publication, Meerut
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

Course Outcomes:

By the end of the course, the students are expected to learn

- (i) The students are expected to acquire necessary background in Trigonometry to appreciate the importance of the geometric study as well as for the calculation and the mathematical analysis.
- (ii) The ability to find the effects of changing conditions on a system.
- (iii) the coordinate geometry provides a connection between algebra and geometry through graphs of lines and curves.
- (iv) Complex numbers enter into studies of physical phenomena in ways that most people cannot imagine.
- (v) The students are expected to acquire necessary background in Determinants and Matrices so as to appreciate the importance of the Determinants as the factors that scale different parameterizations so that they all produce same overall integrals, i.e. they are capable of encoding the inherent geometry of the original shape.

APPLIED PHYSICS-I

Subject Code 2001102	Theory			No of Periods in One Session : 45			Credits 03
	No. of Periods Per Week			Full Marks	:	100	
	L	T	P/S	ESE	:	70	
	02	01	-	TA	:	10	
	-	-	-	CT	:	20	

Course Objectives:

Applied Physics includes the study of a large number of diverse topics all related to materials/things that exist in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which such objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

Teaching Approach:

- Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.
- Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.
- Activity- Theory - Demonstrate/practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content:

Unit 1: Physical world, Units and Measurements

[05]

Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units), Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis.

Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.

Unit 2: Force and Motion

[09]

Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller.

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications.

Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

Unit 3: Work, Power and Energy

[09]

Work: Concept and units, examples of zero work, positive work and negative work Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications. Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples). Power and its units, power and work relationship, calculation of power (numerical problems).

Unit 4: Rotational Motion

[08]

Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications. Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only).

Unit 5: Properties of Matter

[08]

Elasticity: definition of stress and strain, modulus of elasticity, Hooke's law, significance of stress-strain curve.

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.

Viscosity and coefficient of viscosity: Terminal velocity, Stokes law and effect of temperature on viscosity, application in hydraulic systems.

Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynolds number Equation of continuity, Bernoulli's Theorem (only formula and numerical) and its applications.

Unit 6: Heat and Thermometry

[06]

Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses.

Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering applications.

Learning Outcome:

After undergoing this subject, the student will be able to:

- Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy by minimizing different types of errors.
- Represent physical quantities as scalar and vectors and solve real life relevant problems.
- Analyse type of motions and apply the formulation to understand banking of roads/railway tracks and conservation of momentum principle to describe rocket propulsion, recoil of gun etc.
- Define scientific work, energy and power and their units. Derive relationships for work, energy and

power and solve related problems.

- Describe forms of friction and methods to minimize friction between different surfaces.
- State the principle of conservation of energy. Identify various forms of energy, and energy transformations.
- Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
- Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces.
- Describe the viscosity of liquids, coefficient of viscosity and the various factors affecting its value. Determine viscosity of an unknown fluid using Stokes' Law and the terminal velocity.
- Define stress and strain. State Hooke's law and elastic limits, stress-strain diagram, determine; (a) the modulus of elasticity, (b) the yield strength (c) the tensile strength, and (d) estimate the percent elongation.
- Illustrate the terms; heat and temperature, measure temperature in various processes on different scales (Celsius, Fahrenheit, and Kelvin etc.)
- Distinguish between conduction, convection and radiation; identify different methods for reducing heat losses and mode of heat transfer between bodies at different temperatures.
- State specific heats and measure the specific heat capacity of solids and liquids.

References:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
5. Engineering Physics by DK Bhattacharya & PoonamTandan; Oxford University Press, New Delhi.
6. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
7. Practical Physics by C. L. Arora, S. Chand Publication.
8. e-books/e-tools/ learning physics software/websites etc.

APPLIED CHEMISTRY

Subject Code 2001103	Theory			No of Periods in One Session : 45			Credits 03
	No. of Periods Per Week			Full Marks		:	
	L	T	P/S	ESE	:	70	
	02	01	-	TA	:	10	
	-	-	-	CT	:	20	

Course Objectives:

There are numerous number materials used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for students. On successful completion of this course :-

- The students will be able to understand, ascertain and analyse the properties of natural raw materials required for producing economical and eco-friendly finished products.
- Solve various engineering problems applying the basic knowledge of atomic structure and chemical bonding.
- Use relevant water treatment method to solve domestic and industrial problems.
- Solve the engineering problems using knowledge of engineering materials and properties.
- Use relevant fuel and lubricants for domestic and Industrial applications
- Solve the engineering problems using concept of Electrochemistry and Corrosion.

Course Content :

UNIT-I Atomic Structure and Chemical Bonding. [10]

Rutherford Model of Atom, Photoelectric Effect, Bohr's Theory (Expression of Energy and Radius to be omitted) and hydrogen spectrum explanation based on Bohr's Model of Atom, Wave Mechanical model of atom, de Broglie relationship, Heisenberg Uncertainty Principle, Quantum Number, Shapes of Atomic Orbitals, Pauli's Exclusion Principle, Hund's Rule of Maximum Multiplicity, Aufbau Principle, Electronic Configuration (till atomic number 30).

Concept of Chemical bonding – Cause of chemical bonding, Types of Bonds : Ionic Bond (NaCl, CaCl₂, MgO), Covalent Bond, Polar and Non polar Covalent Bonds (H₂, F₂, HF, HCl) & Co-ordinate Bond (CO, NH₄⁺, O₃, H₂SO₄), Dipole Moment (NH₃, NF₃), Hydrogen bonding, Anomalous properties of NH₃, H₂O due to Hydrogen Bonding .

Concept of Hybridisation, Structure and Shape of Simple Inorganic Molecule e.g. BeCl₂, BF₃, CH₄, NH₃, H₂O on the basis of hybridisation.

UNIT-II Water [08]

Introduction, Sources of Water, Hardness of Water, Degree of Hardness (In terms of CaCO₃ equivalent), Unit of Hardness, Quantitative Measurement of Water Hardness by EDTA method. Municipal supply of Water, Disinfection of Water.

Water Softening Technique-Soda Lime Process, Determination of Dissolved Oxygen, Water Quality Index – Biological Oxygen Demand, Chemical Oxygen Demand, Simple Numerical Problems.

UNIT-III Engineering Materials. [08]

Natural Occurrence of Metals, Metallurgy – brief account of general principles of Metallurgy, Gangue, Flux and Slag, Extraction of Aluminum, Iron and Copper from their important ores along with

1. Understand the classification and general properties of engineering materials such as metal, alloys, and composite materials using knowledge of chemical bonding.
2. Understand and assess the suitability of water source for domestic and industrial application, effluents and minimize water pollution.
3. Qualitatively analyze the engineering materials and understand their properties and applications.
4. Choose fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products.
5. a) Ascertain construction, mechanism efficiency of electrochemical cells, solar cell fuel cells
b) Understand corrosion and develop economical prevention techniques.

References/Suggested Learning Resources:

(a) Books :

- 1) Text Book of Chemistry for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
- 2) Agrawal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
- 3) C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
- 4) Dara, S. S. & Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, 2015.
- 5) Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
- 6) Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
- 7) Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
- 8) Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

(b) Open source software and website address:

- 1 www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
- 2 www.visionlearning.com (Atomic structure and chemical bonding)
- 3 www.chem1.com (Atomic structure and chemical bonding)
- 4 <https://www.wastewaterelearning.com/elearning/> (Water Treatment)
- 5 www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
- 6 www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)
- 7 www.chemcollective.org (Metals, Alloys)
- 8 www.wqa.org(Water Treatment)

COMMUNICATION SKILLS IN ENGLISH

Subject Code 2001104	Theory			No of Periods in One Session : 30			Credits 02
	No. of Periods Per Week			Full Marks	:	100	
	L	T	P/S	ESE	:	70 (50Eng.+20 Hindi)	
	02	-	-	TA	:	10	
	-	-	-	CT	:	20	

Course Objectives:

Communication skills play an important role in career development. This course aims at introducing basic concepts of communication skills with an emphasis on developing personality of the students. Thus, the main objectives of this course are:

To develop confidence in speaking English with correct pronunciation;

To develop communication skills of the students i.e. listening, speaking, reading and writing skills; and

To introduce the need for personality development.

Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc.

Course Content :

Part - A (English)

F.M. - 50(English)

UNIT - 1 COMMUNICATION: THEORY AND PRACTICE

[04]

- ♦ **Basics of Communication:** Introduction, Meaning and Definition, Process of Communication, Elements of Communication: Sender-Message-Channel-Receiver-Feedback & Context, Feedback: Definition & Importance.
- ♦ **Types of Communication:** Formal and Informal, Verbal-Non-verbal, Types of Verbal Communication: Oral and Written, Non-Verbal Codes such as Kinesics, Proxemics, Haptics, Vocalics, Chronemics, Physical Appearance; Tables, Charts and Graphs in Graphic Communication Oral and Written.

UNIT - 2 EFFECTIVE COMMUNICATION AND COMMUNICATION BARRIERS [04]

- ♦ **Concept, 7 Cs for Effective Communication (Considerate, Concrete, Concise, Clear, Complete, Correct, Courteous);**
- ♦ **Art of Effective Communication: Choosing Words, Voice, Modulation, Clarity, Time, Simplification of Words.**
- ♦ **Different Barriers to Communication, Ways to Remove/Minimize.**

UNIT - 3 READING COMPREHENSION

[03]

- ♦ **Comprehension and Vocabulary enhancement based on reading of the following texts:**

SECTION-1

Malgudi Days:

R.K. Narayan

What Students Can Do:

Mohandas Karamchand Gandhi

The Secret of Work :

Swami Vivekanand

SECTION-2

Stopping by Woods on a Snowy Evening:

Robert Frost

Where the Mind Is without Fear:

Rabindranath Tagore

Ode on Solitude:

Alexander Pope

A Psalm of Life:

H.W. Longfellow

UNIT - 4 FORMAL WRITTEN SKILLS/PROFESSIONAL WRITING

[04]

- ◆ Application to Principal/Librarian.
- ◆ Drafting E-mails, Messages and Notices.
- ◆ Business Letters: Enquiry Letter, Order Letter, Complaint Letter, Adjustment Letter.
- ◆ Application / Official Letter Writing.
- ◆ Report Writing.

UNIT - 5 VOCABULARY AND GRAMMAR

[05]

- ◆ Vocabulary of Common Words.
- ◆ One Word Substitution, Common Idioms and Phrases.
- ◆ Use of Synonyms & Antonyms.
- ◆ Parts of Speech, Simple Sentence and Question, Adding Question-Tags, Removal of 'Too', Active Voice into Passive Voice, Direct Speech into Indirect Speech (in cases of Simple Sentence and Question), Punctuation.

Part-B (Hindi)

कुल-20 अंक (हिन्दी)

UNIT - 1. सम्प्रेषण - सिद्धांत एवं व्यवहार

02]

[

सम्प्रेषण - परिचय, अर्थ एवं परिभाषा, सम्प्रेषण की प्रक्रिया

1. सम्प्रेषण के प्रकार - औपचारिक एवं अनौपचारिक, शाब्दिक एवं अशाब्दिक
2. प्रभावशाली सम्प्रेषण के सिद्धांत एवं व्यवधान
3. प्रभावशाली सम्प्रेषण कौशल - शब्द चयन, आवाज़, स्वर परिवर्तन, स्वर सामंजस्य, स्पष्टता, शब्दों की सरलता
4. तकनीकी सम्प्रेषण

UNIT - 2. व्यावसायिक उत्कृष्टता हेतु व्यवहार कौशल

[02]

1. परिचय - तकनीकी कौशल एवं व्यवहार कौशल
2. व्यवहार कौशल का महत्व
3. जीवन कौशल - आत्म जागरूकता एवं आत्म विश्लेषण
4. भावनात्मक बुद्धिमता एवं करुणा, अनुकूलनशीलता एवं लचीलापन
5. व्यवहार कौशल का उपयोग - वृत्त अध्ययन

निर्धारित पाठ्य सामग्री -

- (क) प्रेमचंद की कहानियाँ - शतरंज के खिलाड़ी, नमक का दारोगा, ईदगाह, पूस की रात
 (ख) रविन्द्रनाथ टैगोर की रचना-मन जहां भय से मुक्त हो
 (ग) कबीर के पद एवं दोहे

UNIT - 4. लेखन कौशल

[02]

1. सार लेखन
2. औपचारिक पत्र लेखन - कार्मिक एवं व्यावसायिक पत्र , सरकारी पत्र, अर्द्धसरकारी पत्र-लेखन
3. प्रारूप लेखन - सूचना, बायोडाटा, निविदा लेखन, प्रतिवेदन-लेखन

UNIT - 5. शब्दावली एवं व्याकरण

[02]

1. सामान्य शब्दावली
2. प्रशासनिक शब्दावली
3. शब्द भेद, अनेक शब्दों के लिए एक शब्द
4. विराम चिन्ह
5. मुहावरें एवं कहावतें

References:

1. J.D.O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 1980.
2. Lindley Murray. *An English Grammar: Comprehending Principles and Rules*. London: Wilson and Sons, 1908.
3. Kulbhushan Kumar, *Effective Communication Skills*, Khanna Publishing House, New Delhi (Re-vised Edition 2018)
4. Margaret M. Maisson. *Examine your English*. Orient Longman: New Delhi, 1964.
5. M. Ashraf Rizvi. *Effective Technical Communication*. Mc-Graw Hill: Delhi, 2002.
6. John Nielson. *Effective Communication Skills*. Xlibris, 2008.
7. *Oxford Dictionary*
8. *Roget's Thesaurus of English Words and Phrases*
9. *Collin's English Dictionary*

Course outcomes:

At the end of this course, the participants will:

- Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
- Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
- Also develop skills of group presentation and communication in team.
- Develop non-verbal communication such as proper use of body language and gestures.

ENGG. GRAPHICS

Subject Code 2001105	Theory			No of Periods in One Session : 45			Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	-	-	TA	:	10	
	-	-	-	CT	:	20	

Course Objectives:

- To understand the language of graphics which is used to express ideas, convey instructions while carrying out engineering jobs.
- To develop drafting and sketching skills, to know the applications of drawing equipments, and get familiarize with Indian Standards related to engineering drawings.
- To develop skills to visualize actual object or a part of it, on the basis of drawings.
- To develop skills to translate ideas into sketches and to draw and read various engineering curves, projections and dimensioning styles.
- To understand the basic commands and develop basic skills related to computer aided drafting, of how to draw, modify, and edit basic shapes (2D), using AUTOCAD.

Course Content

UNIT – I Basic elements of Drawing

[06]

Drawing Instruments and supporting materials: method to use them with applications. Convention of lines and their applications.

Representative Fractions – reduced, enlarged and full size scales; Engineering Scales such as plain and diagonal scale.

Dimensioning techniques as per SP-46:2003 – types and applications of chain, parallel and coordinate dimensioning.

Geometrical and Tangency constructions. (Redraw the figure)

UNIT – II Orthographic projections

[08]

Introduction of projections-orthographic, perspective, isometric and oblique: concept and applications.

Introduction to orthographic projection, First angle and Third angle method, their symbols.

Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Projection method only)

UNIT – III Isometric Projections

[08]

Introduction to isometric projections.

Isometric scale and Natural scale.

Isometric view and isometric projection.

Illustrative problems related to objects containing lines, circles and arcs shape only. Conversion of orthographic views into isometric view/projection.

UNIT – IV Free Hand Sketches of engineering elements

[07]

Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washer, Locking arrangements. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching) Free hand sketches of orthographic view (on squared graph paper) and isometric view (on isometric grid paper)

Computer Aided Drafting: concept. Hardware and various CAD software available.

System requirements and Understanding the interface.

Components of AutoCAD software window: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify tool bar, cursor cross hair. Command window, status bar, drawing area, UCS icon.

File features: New file, Saving the file, Opening an existing drawing file, Creating templates, Quit.

Setting up new drawing: Units, Limits, Grid, Snap.

Undoing and redoing action.

UNIT – VI Computer aided drafting

[08]

Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, PolyLine.

Method of Specifying points: Absolute coordinates, Relative Cartesian and Polar coordinates.

Modify and edit commands like trim, extend, delete, copy, offset, array, block, layers.

Dimensioning: Linear, Horizontal Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions.

Dim scale variable.

Editing dimensions.

Text: Single line Text, Multiline text.

Standard sizes of sheet. Selecting Various plotting parameters such as Paper size, paper units, Drawing orientation, plot scale, plot offset, plot area, print preview.

S. No.	Exercises	Unit No.
1	Draw horizontal, Vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/ drafter. (do this exercise in sketch book)	I
2	Write alphabets and numerical (Vertical only) (do this exercise in sketch book)	I
3	Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part I	II
4	Draw regular geometric construction and redraw the given figure (do this exercise in sketch book) Part II	II
5	Draw a problem on orthographic projections using first angle method of projection having plain surfaces and slanting. Part I	III
6	Draw another problem on orthographic projections using first angle method of projection having slanting surfaces with slots. Part II	III
7	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part I	III
8	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part I	IV
9	Draw some problems on Isometric projection of simple objects having cylindrical surface by using isometric scale. Part I	IV

10	Draw free hand sketches/ conventional representation of machine elements `in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part I	V
11	Problem based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book. Part I	III, II, V
12	Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD (Print out should be a part of progressive assessment). Part I	V
13	Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD (Printout should be a part of progressive assessment). Part II	V
14	Draw basic 2D entities like: Circular and rectangular array using AutoCAD (Printout should be a part of progressive assessment). Part III	V
15	Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment). Part IV	V
16	Draw basic branch specific components in 2D using AutoCAD (Print out should be a part of term work). Part I	VI
17	Draw complex branch specific components in 2D using AutoCAD (Print should be a part of progressive assessment). Part I	VI
	Total	

SUGGESTED LEARNING RESOURCES

1. Bureau of Indian Standards. *Engineering Drawing Practice for Schools and Colleges IS: Sp-46*. BIS. Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2.
2. Bhatt, N. D. *Engineering Drawing*. Charotar Publishing House, Anand, Gujrat 2010; ISBN: 978-93- 80358-17-8.
3. Jain & Gautam, *Engineering Graphics & Design*, Khanna Publishing House, New Delhi (ISBN: 978- 93-86173-478)
4. Jolhe, D. A. *Engineering Drawing*. Tata McGraw Hill Edu. New Delhi, 2010; ISBN: 978-0-07- 064837-1
5. Dhawan, R. K. *Engineering Drawing*. S. Chand and Company, New Delhi; ISBN: 81-219-1431-0.
6. Shah, P. J. *Engineering Drawing*. S. Chand and Company, New Delhi, 2008, ISBN:81-219-2964-4.
7. Kulkarni, D. M.; Rastogi, A. P.; Sarkar, A. K. *Engineering Graphics with AutoCAD*. PHI Learning Pri- vate Limited-New Delhi (2010); ISBN: 978-8120337831.
8. Jeyapoovan, T. *Essentials of Engineering Drawing and Graphics using AutoCAD*. Vikas Publishing House Pvt. Ltd, Noida, 2011; ISBN: 978-8125953005.
9. Autodesk. *AutoCAD User Guide*. Autodesk Press, USA, 2015.

10. Sham, Tickoo. *AutoCAD 2016 for Engineers and Designers*. Dreamtech Press; Galgotia Publication, New Delhi, 2015; ISBN 978-9351199113.

Software/Learning Websites

1. <https://www.youtube.com/watch?v=TJ4jGyD-WCw>
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. <https://www.youtube.com/watch?v=MQScnLXL0M>
4. <https://www.youtube.com/watch?v=3WXPanCq9LI>
5. <https://www.youtube.com/watch?v=fvjk7PlxAuo>
6. <http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf>
7. <https://www.machinedesignonline.com>

Course Outcomes

Following outcomes will be achieved:

- 1) Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing
- 2) Draw views of given object and components 3) Sketch orthographic projections into isometric projections and vice versa.
- 3) Apply computer aided drafting tools to create 2D engineering drawings

APPLIED PHYSICS LAB-I

Subject Code 2001106	Practical			No of Periods in One Session : 45			Credits
	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	Internal(PA)	:	15	
		-	03	External(ESE)	:	35	

Course Objectives

Study of Applied Physics aims to give an understanding of physical world by observations and predictions. Concrete use of physical principles and analysis in various fields of engineering and technology is very prominence. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get necessary confidence in handling equipment and thus learn various skills in measurement.

List of Practical's (To perform minimum 10 practical's).

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook's Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the viscosity of a given liquid (Glycerin) by Stokes law.
10. To find the coefficient of linear expansion of the material of a rod.
11. To determine atmospheric pressure at a place using Fortin's barometer.
12. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

Learning Outcome:

After undergoing this lab work, the student will be able to:

- Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer etc.) for determining dimensions of physical quantities and make measurements with accuracy and precision.
- Differentiate various shapes and determine dimensions of plane, curved and regular surfaces/bodies.
- Apply and Verify laws of forces and determine resultant force acting on a body.
- Appreciate role of friction and measure co-efficient of friction between different surfaces.
- Describe and verify Hook's law and determine force constant of spring body.
- Identify various forms of energy, energy transformations and verify law of conservation of energy.
- Understand rotational motion and determine M.I. of a rotating body (flywheel)
- Understand Stokes law for viscous liquids and determine viscosity of a given liquid.
- Understand how materials expand on heating and determine linear expansion coefficient for

a given material rod. Understand working and use Fortin's barometers for determining pressure at a place.

- Understand use of thermometers to measure temperature under different conditions and different scales of temperature measurements.

SUGGESTED STUDENT ACTIVITIES & STRATEGIES

Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course

- a. Make survey of different physical products and compare the following points
 - Measurements of dimensions
 - Properties
 - Applications
- b. Library survey regarding engineering materials/products used in different industries
- c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler or descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences.

References:

1. Text Book of Physics for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P)Ltd.,
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. e-books/e-tools/ learning physics software/YouTube videos/websites etc.

APPLIED CHEMISTRY LAB

Subject Code 2001107	Practical			No of Periods in One Session : 45			Credits 02
	No. of Periods Per Week			Full Marks	:	50	
	L	T	P/S	Internal(PA)	:	15	
		-	03	External(ESE)	:	35	

Course Objectives:

There are numerous number of materials used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for students. The course aims to supplement the factual knowledge gained in the lectures by first hand manipulation of processes and apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving technology based problems. In addition, students will get necessary confidence in handling equipments and thus learn various skills in measurement.

List of Practicals : Perform any 12 (twelve) Practicals :-

1. Preparation of 250ml N/10 Oxalic acid Solution.
2. Preparation of 250ml N/10 Sodium Carbonate Solution.
3. To determine the strength of Sodium Hydroxide Solution by Titrating against Oxalic Acid Solution.
4. Determination of Temporary Hardness of Tap Water.
5. Gravimetric Estimation of Moisture in given Coal Sample.
6. Determination of Percentage of Water of Crystallization in Barium Chloride.
7. Preparation of Cupric Oxide from Copper Sulphate.
8. Preparation of Barium Sulphate from Barium Chloride.
- 9-11. Qualitative Analysis of Three Solutions containing One Basic and One Acid radicals Listed below.
Basic radicals – NH_4^+ , Pb^{+2} , Cu^{+2} , Ni^{+2} , Zn^{+2} , Fe^{+2} .
Acid radicals – Cl^- , Br^- , I^- , NO_3^- , CO_3^{-2} , SO_4^{-2} .
12. Determination of Viscosity of Lubricating Oil Using Ostwald Viscometer.
13. To Verify Faradays First Law of Electrolysis.
14. To determine pH of given solution by pH meter.
15. Prepare Phenol Formaldehyde Resin (Bakelite)
16. To Determine Dissolved Oxygen in given Sample of Water.

Learning Outcomes:

At the end of the course student will be able to

- To express quantitative measurements accurately.
- To practice and adapt good measuring techniques.
- To use various apparatus for precise measurements.
- To understand and differentiate different methods of quantitative analysis.
- To know and understand principles of quantitative analysis using instruments.

- To construct different electrochemical cells used in developing batteries.
- To understand and appreciate methods of corrosion abetments.

Reference Books:

1. Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2. Dr. G. H. Hugar and Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
3. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.
4. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.

COMMUNICATION SKILLS IN ENGLISH LAB

Subject Code 2001108	Practical			No of Periods in One Session : 45			Credits 02
	No. of Periods Per Week			Full Marks	:	50	
	L	T	P/S	Internal(PA)	:	15	
		-	03	External(ESE)	:	35	

Course Objectives:

Communication skills play an important role in career development. This lab course aims at actively involving students in various activities to improve their communication skills with an emphasis on developing personality of the students. Thus, the objectives of this course are:

1. To develop listening skills for enhancing communication.
2. To develop speaking skills with a focus on correct pronunciation and fluency.
3. To introduce the need for Personality development- Focus will be on developing certain qualities which will help students in handling personal and career challenges, leadership skills etc. For that purpose group discussion, extempore and other activities should be conducted during lab classes.

Course Content:

UNIT- 1 Listening Skills

Listening Process and Practice: Introduction to recorded lectures, poems, interviews and speeches, listening tests.

UNIT- II Introduction to Phonetics

Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), weak forms, syllable division, word stress, intonation, voice etc.

UNIT- III Speaking Skills

Standard and formal speech: Group discussion, oral presentations, public speaking, extempore speech, business presentations conversation practice and role playing, mock interviews etc.

UNIT- IV Building Vocabulary

Etymological study of words and construction of words, phrasal verbs, idioms and phrases.
Jargon/ Register related to organizational set up, word exercises and word games to enhance self-expression and vocabulary of participants.

Recommended Readings:

1. Daniel Jones. *The Pronunciation of English*. Cambridge: Cambridge University Press, 1956.
2. James Hartman & et al. Ed. *English Pronouncing Dictionary*. Cambridge: Cambridge University Press 2006.
3. Kulbhushan Kumar, *Effective Communication Skills*, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. J.D.O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 1980.
5. Lindley Murray. *An English Grammar: Comprehending Principles and Rules*. London: Wilson and Sons, 1908.
6. Margaret M. Maisson. *Examine your English*. Orient Longman: New Delhi, 1964.
7. J.Sethi & et al. *A Practice Course in English Pronunciation*. New Delhi: Prentice Hall, 2004.
8. Pfeiffer, William Sanborn and T.V.S Padmaja. *Technical Communication: A Practical Approach*. 6th ed. Delhi: Pearson, 2007.

Learning Outcome:

- At the end of this course the students will be able to communicate effectively with an increase in their confidence to read, write and speak English fluently.
- They will also demonstrate a significant increase in word power.
- The variety of exercises and activities that will be conducted in the Language Lab will develop their skills needed to participate in a conversation like listening carefully and respectfully to others' viewpoints; articulating their own ideas and questions clearly and over all students will be able to prepare, organize, and deliver an engaging oral presentation.
- They will also develop non-verbal communication such as proper use of body language and gestures.

ENGINEERING WORKSHOP PRACTICE

Subject Code 2001109	Term Work			No of Periods in One Session : 90			Credits 02
	No. of Periods Per Week			Full Marks	:	25	
	L	T	P/S	Internal(PA)	:	07	
		-	06	External(ESE)	:	18	

Course Objectives:

- To understand basic engineering processes for manufacturing and assembly.
 - To understand, identify, select and use various marking, measuring, and holding, striking and cutting tools and equipment's
 - To understand and interpret job drawings, produce jobs, and inspect the job for specified dimensions
 - To understand the various types of wiring systems and acquire skills in house wiring
 - To understand, operate, control different machines and equipment's adopting safety practices
- Course Content:

Course Content :

- I Carpentry:** i) Demonstration of different wood working tools / machines. [16]
 ii) Demonstration of different wood working processes, like planing, marking, chiseling, grooving, turning of wood etc. iii) One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.
- II Fitting:** i) Demonstration of different fitting tools and drilling machines and power tools [16]
 ii) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc.
 iii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc
- III Welding:** i) Demonstration of different welding tools / machines. ii) Demonstration on Arc [16]
 15]Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint
- IV Sheet Metal Working:** i) Demonstration of different sheet metal tools / machines. [16]
 ii) Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting. iii) One simple job involving sheet metal operations and soldering and riveting.
- V Electrical House Wiring:** Practice on simple lamp circuits (i) one lamp controlled by one [16]
 switch by surface conduit wiring, (ii) Lamp circuits- connection of lamp and socket by separate switches, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-in- stall bedroom lighting. And (v) Simple lamp circuits- install stair case wiring.
- VI Demonstration:** i) Demonstration of measurement of Current, Voltage, Power and Energy. [10]
 ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. iii)
 Tools for Cutting and drilling

References:

1. S.K. Hajara Chaudhary, Workshop Technology, Media Promoters and Publishers, New Delhi, 2015
2. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai and sons, New Delhi 2014
3. K. Venkat Reddy, Workshop Practice Manual, BS Publications, Hyderabad 2014
4. Kents Mechanical Engineering Hand book, John Wiley and Sons, New York Course outcomes

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

- CO1 Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines
- CO2 Understand job drawing and complete jobs as per specifications in allotted time
- CO3 Inspect the job for the desired dimensions and shape
- CO4 Operate, control different machines and equipment's adopting safety practices

SPORTS AND YOGA

Subject Code 2001110	Term Work			No of Periods in One Session : 30			Credits 02
	No. of Periods Per Week			Full Marks	:	25	
	L	T	P/S	Internal(PA)	:	07	
		-	02	External(ESE)	:	18	

Course Objectives:

- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Content:

- **Introduction to Sports**
 - Meaning & Definition of Sports
 - Aims & Objectives of Physical Education
 - Awards and Honours in the Field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)
- **Physical Fitness, Wellness & Lifestyle**
 - Meaning & Importance of Physical Fitness & Wellness
 - Components of Physical Fitness
 - Components of Wellness
 - Preventing Health Threats through Lifestyle Change
 - Concept of Positive Lifestyle
- **Postures**
 - Meaning and Concept of Postures.
 - Causes of Bad Posture.
 - Concept & Advantages of Correct Posture.
- **Yoga**
 - Meaning & Importance of Yoga
 - Elements of Yoga
 - Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
 - Yoga for Concentration & Related Asanas (Sukhasana; Tadasana; Padmasana & Sha-shankasana)

- **Yoga & Lifestyle**

- Asanas as Preventive Measures.
- Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
- Obesity: Procedure, Benefits & Contraindications for Vajrasana.
- Back Pain: Tadasana, Ardh Matsyendrasana, Bhujangasana.
- Diabetes: Procedure, Benefits & Contraindications for Bhujangasana, Paschimottasana, Ardh Matsyendrasana.
- Asthma: Procedure, Benefits & Contraindications for Sukhasana, Bhujangasana , Matsyasana.

- **Psychology & Sports**

- Psychological Benefits of Exercise.
- Anxiety & Fear and Its Effects on Sports Performance.
- Motivation, Its types & Techniques.
- Understanding Stress & Coping Strategies.

- **Sports / Games**

Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Chess, Cricket, Kabaddi, Table Tennis, Volleyball, Yoga etc.

- History of the Games/Sport.
- Latest General Rules of the Games/Sports.
- Specifications of Play Fields and Related Sports Equipment.
- Important Tournaments and Venues.
- Sports Personalities.

References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

Course Outcomes:

On successful completion of the course the students will be able to:

- (i) Practice Physical activities and Hatha Yoga focusing on Yoga for strength, flexibility, and relaxation.
- (ii) Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
- (iii) Learn breathing exercises and healthy fitness activities
- (iv) Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.

- (v) Perform Yoga movements in various combination and forms.
- (vi) Assess current personal fitness levels.
- (vii) Identify opportunities for participation in Yoga and Sports activities.
- (viii) Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
- (ix) Improve personal fitness through participation in Sports and Yogic activities.
- (x) Develop understanding of psychological problems associated with the age and lifestyle.
- (xi) Demonstrate an understanding of sound nutritional practices as related to health and physical performance.
- (xii) Assess Yoga activities in terms of fitness value.
- (xiii) Identify and apply injury prevention principles related to Yoga and physical fitness activities.
- (xiv) Understand and correctly apply biomechanical and physiological principles related to exercise and training.

C / KYP / IT ESSENTIAL / PYTHON / OTHERS

Subject Code 2001111	Term Work			No of Periods in One Session : 30			Credits
	No. of Periods Per Week			Full Marks	:	50	
	L	T	P/S	Internal(PA)	:	15	01
		-	02	External(ESE)	:	35	