



## **COURSE HAND-OUT**

### **PTU B.TECH. - SEMESTER I**

#### **DEPARTMENT OF ELECTRICAL ENGINEERING**

#### **Bhai Gurdas Institute of Engineering & Technology**

#### **VISION**

To impart value based multidisciplinary quality education to the students which can enable them to contribute their knowledge in industrial development, technology revolution and economic growth of the nation with global Perspective.

#### **MISSION**

<b>Mission No.</b>	<b>Mission Statements</b>
M1	To develop technical manpower of quality standards with capabilities of accepting new challenges.
M2	To provide teaching and research environment.
M3	To promote collaborative coexistence amongst academic institute and industries for resources sharing.

## **DEPARTMENT OF ELECTRICAL ENGINEERING,BGIET**

### **VISION**

- It is aimed to provide the finest environment for teaching, learning, research, innovation and character building so as to mould youth of today into world-class technocrats of tomorrow who would Endeavour to increase the quality of life for mankind.
- To provide quality technical education to prepare globally competent and ethically strong Electrical Engineers with power of innovation to contribute the knowledge for the betterment of society .
- To emerge as a leading Department of Electrical Engineering that caters to the latest needs of power sector, electrical & allied industry in the region.

### **MISSION**

M1: To evolve as an innovative & globally competent Electrical Engineering department that contributes to the socio - economic growth of region by utilizing the advancement in Electrical Engineering by providing conducive learning and interactive environment to students and faculty.

M2: To impart the quality education and enhance skills for developing globally competent Electrical Engineers.

M3: To provide state –of –the –art facilities and opportunities to create, interpret, apply and disseminate knowledge.

M4: To develop students and faculty to cope up with modern technology with research attitude to meet industry standards effective industry interface.

## **B.TECH PROGRAMME**

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

1. To provide students with strong fundamentals of basic sciences and domain knowledge of Electrical Engineering.
2. To develop multidisciplinary approach and to develop their professional competency.
3. To enable students to design and analyze system, and develop solution for real life engineering problems.
4. To inculcate professionalism, ethics, communication, teamwork and leadership skills in students to serve for the betterment of the industry

## PROGRAMME OUTCOMES (POs)

Graduates will be able to achieve

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## INDEX

### SCHEME: B.TECH 1ST SEMESTER

### (ELECTRICAL ENGINEERING)

### I.K. Gujral Punjab Technical University Revised Scheme for B.Tech Syllabus 2018

Slot	Course No.	Subject	L-T-P	Hours	Credits
A	BTCH101-18	Chemistry-I	3-1-0	4	4
B	BTCH102-18	Chemistry-I (Lab)	0-0-3	3	1.5
C	BTAM101-18	Math-I	3-1-0	4	4
D	BTPS101-18	Programming for Problem Solving	3-0-0	3	3
E	BTPS102-18	Programming for Problem Solving (Lab)	0-0-4	4	2
F	BTMP101-18	Workshop / Manufacturing Practices	1-0-4	5	3
G	BTHU101-18	English	2-0-0	2	2
H	BTHU102-18	English (Lab)	0-0-2	2	1
I	BMPD101-18	Mentoring and Professional Development	0-0-2	2	0

**Total Credits = 20.5**

**Hours: 29**

**BTCH101-18 CHEMISTRY-I****COURSE INFORMATION SHEET**

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE- CHEMISTRY-I	SEMESTER-1 CREDITS-4
COURSE CODE- BTCH101-18 Year of introduction – 2018	COURSE TYPE - CORE
COURSE AREA/DOMAIN- CHEMISTRY	CONTACT HOURS: 3-1-0
CORRESPONDING LAB COURSE CODE (IF ANY): BTCH102-18	LAB COURSE NAME: CHEMISTRY-I LAB

**SYLLABUS:**

<b>MODULE</b>	<b>DETAILS</b>	<b>HOURS</b>
<b>I</b>	<b>Atomic and molecular structure</b>  Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nano particles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	12
<b>II</b>	<b>Spectroscopic techniques and applications</b>  Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.	8
<b>III</b>	<b>Intermolecular forces and potential energy surfaces</b>  Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H <sub>3</sub> , H <sub>2</sub> F and HCN and trajectories on these surfaces.	4
<b>IV</b>	<b>Use of free energy in chemical equilibria</b>  Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.  Use of free energy considerations in metallurgy through Ellingham diagrams.	6
<b>V</b>	<b>Periodic properties</b>	4

	Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries	
<b>VI</b>	<b>Stereochemistry</b>  Representations of 3 dimensional structures, structural isomers and stereoisomer's, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds	4
<b>VII</b>	<b>Organic reactions and synthesis of a drug molecule</b>  Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	4

**Total hours – 42**

**TEXT/REFERENCE BOOKS:**

<b>S.No</b>	<b>BOOK TITLE/AUTHORS/PUBLICATION</b>
1.	University chemistry, by B. H. Mahan
2.	Chemistry: Principles and Applications, by M. J. Sienko and R.A. Plane
3.	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4.	Physical Chemistry, by P. W. Atkins
5.	Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5thEdition <a href="http://bcs.whfreeman.com/vollhardtschore5e/default.asp">http://bcs.whfreeman.com/vollhardtschore5e/default.asp</a>

<b>T/R</b>	<b>BOOK TITLE SUGGESTED BY FACULTY</b>
1	Conceptual of engineering chemistry, by Dr. S.K.Bhasin.
2	Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M.S Krishnan.

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Small Group Instruction.
- Making real world connections
- Presentatons

**E- CONTENT USED:**

- <https://youtu.be/dkARLSQWHH8>

**ADDITIONAL TOPICS:**

- Huckel's rule and concept of aromaticity
- Fullerenes

**COURSE OBJECTIVES:**

The aim and objective of the course on Chemistry-I is to introduce the students of B. Tech. class to the formal structure of Chemistry-I so that they can use these in Engineering as per their requirement.

**COURSE OUTCOMES:**

Course: CHEMISTRY-I		
Subject Code- BTCH101-18		
	Course Outcomes	BT Level
1	Illustrate the structures of diatomic and polyatomic in terms of molecular orbital's and relate intermolecular forces.	2
2	Interpret the molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data.	2
3	Make use of free energy in chemical equilibria and relate intermolecular forces.	3
4	Analyze periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity	4
5	Determine the stereochemistry of organic compounds and major chemical reactions that are used in the synthesis of molecules.	5
6	Formulate the reactivity/stability of compound and identification of drug molecule.	6

**CO MAPPING WITH PO:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1								2		1	1
CO2	2		1	1								2	1	1	1
CO3	1	1	1	1								2			1
CO4	2	1	2	1								2	1	1	
CO5	1	1	1	1								2			
CO6		1	1				1					2		1	

**BTCH102-18 CHEMISTRY-I(LAB)****COURSE INFORMATION SHEET**

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE AREA/DOMAIN- CHEMISTRY	CONTACT HOURS: 0(L)-0(T)-3(P)
CORRESPONDING LAB COURSE CODE (IF ANY): BTCH102-18	LAB COURSE NAME: CHEMISTRY-I LAB

**SYLLABUS:****PRACTICALS****Choice of 10-12 experiments from the following**

▪ Determination of surface tension and viscosity
▪ Thin Layer Chromatography
▪ Ion exchange column for removal of hardness of water
▪ Colligative properties using freezing point depression
▪ Determination of the rate constant of a reaction
▪ Determination of cell constant and conductance of solutions
▪ Potentiometry-determination of redox potentials and emf
▪ Synthesis of a polymer/drug
▪ Saponification/acid value of an oil
▪ Chemical analysis of a salt
▪ Lattice structures and packing of spheres
▪ Models of potential energy surfaces
▪ Chemical oscillations- Iodine clock reaction
▪ Determination of the partition coefficient of a substance between two immiscible liquids
▪ Adsorption of acetic acid by charcoal

**TEXT/REFERENCE BOOKS:**

S.NO	BOOK TITLE/AUTHORS/PUBLICATION
1	Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications.
2	Vogel's <i>Textbook</i> of Quantitative chemical analysis
3	<i>Text Book of engineering chemistry</i> by. R. N. Goyal and HarimendraGoel, Ane Books Private Ltd.,
4	Practical Engineering Chemistry by K. Mukkanti, etal, B.S. Publications, Hyderabad.

T/R	BOOK TITLE SUGGESTED BY FACULTY
1	Inorganic quantitative analysis, Vogel.
2	<i>Laboratory Manual on Engineering Chemistry</i> , Sudharani (Dhanpat Rai Publishing Company).

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

Chalk & Talk

Small Group Instruction.

Making real world connections

Presentatons

**E- CONTENT USED:**

<https://youtu.be/qvUyVrUb8Fo>

**ADDITIONAL TOPICS:**

Aim and objective of the Lab course on Chemistry is to introduce the students of B.Tech. class to the formal structure of Chemistry so that they can use these in Engineering as per their requirement.

**COURSE PRE-REQUISITES:**

C.CODE	COURSE NAME	DESCRIPTION	SEM
BTCH102-18	Chemistry Lab-I	Introduction to Chemistry lab	1 & 2



**COURSE OUTCOMES:**

<b>Course: CHEMISTRY-I LAB</b>		
<b>Subject Code- BTCH102-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
<b>1.</b>	Classify different physical properties such as surface tension and viscosity of unknown liquids.	2
<b>2.</b>	Build skills in method of creating different chromatographic techniques.	3
<b>3.</b>	Make use of the rate constants, cell constant, redox potentials and conductance for different chemical solutions.	3
<b>4.</b>	Survey basic techniques and procedures in laboratory for synthesis and purification of any organic compounds	4
<b>5.</b>	Inspect acid value of oil and analysis of salt.	4
<b>6.</b>	Measure the partition coefficient of substance and adsorption of acetic acid by different methods.	5

**CO MAPPING WITH PO:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>												1	1		1
<b>CO2</b>	2	1	1									1		1	
<b>CO3</b>	2	1	1									1			
<b>CO4</b>												1		1	
<b>CO5</b>												1			
<b>CO6</b>												1			

## MATHEMATICS -I

### COURSE INFORMATION SHEET

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE- MATHEMATICS PAPER-I	SEMESTER-1 CREDITS-5
COURSE CODE- BTAM101-18 Year of introduction – 2018	COURSE TYPE - CORE
COURSE AREA/DOMAIN- MATHEMATICS	CONTACT HOURS: 4-1-0
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NA

### SYLLABUS:

MODULE	DETAILS	HOURS
<b>I</b>	<b>Calculus</b> Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	10
<b>II</b>	<b>Multivariable Calculus</b> Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).	15
<b>III</b>	<b>Sequences and Series</b> Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Leibnitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.	12
<b>IV</b>	<b>Matrices</b> Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.	13

**Total hours – 50**

**TEXT/REFERENCE BOOKS:**

<b>Sr.</b>	<b>BOOK TITLE/AUTHORS/PUBLICATION</b>
1.	G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2.	T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.
3.	B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
4.	D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

<b>Sr.</b>	<b>BOOK TITLE SUGGESTED BY FACULTY</b>
1.	Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

Chalk & Talk

Small Group Instruction.

Making real world connections

Inquiry-based Learning

**E- CONTENT USED:**

<https://youtu.be/eTp5wq-cSXY>

[https://youtu.be/LYYGJ\\_5qx5M](https://youtu.be/LYYGJ_5qx5M)

**ADDITIONAL TOPICS:**

The fundamental theorem of line integrals

Raabe's test

Cauchy's Root test

**COURSE OBJECTIVES:**

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

**COURSE OUTCOMES:**

<b>Course: MATHEMATICS-I</b>		
<b>Course Code: BTAM101-18</b>		
	<b>Course Outcomes</b>	<b>BT LEVEL</b>
<b>1</b>	Understand the fundamental concepts of pure and applied mathematics to enhance mathematical skills	<b>2</b>
<b>2</b>	Apply differential and integral calculus to evaluate definite, improper integrals and its applications.	<b>3</b>
<b>3</b>	Make use of limit, continuity, differentiation and determine the optimal points of single variable and multivariable functions	<b>3</b>
<b>4</b>	Simplify the integration w.r.t multiple variables and also apply the same to determine the areas and volumes using double integration using change of order or change of variables, if needed.	<b>4</b>
<b>5</b>	Determine the convergence and divergence conditions of various types of infinite series.	<b>5</b>
<b>6</b>	Solve linear system of equations ,find the Eigen values and Eigen vectors and also apply Cayley Hamilton theorem.	<b>6</b>

**CO MAPPING WITH PO:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	3	3	2	2								2	1	1	
<b>CO2</b>	2	2	2		1							1	1	1	1
<b>CO3</b>	3	1	1										1		1
<b>CO4</b>	3	3		1								2		1	
<b>CO5</b>	3	3		2								2	1		1
<b>CO6</b>	2	2	2	2								2		1	

**BTPS101-18 COURSE INFORMATION SHEET****SYLLABUS**

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE:PPS	SEMESTER-2 CREDITS-3
COURSE CODE- BTPS101-18 Year of Introduction – 2018	COURSE TYPE – CORE
COURSE AREA/DOMAIN- PPS	CONTACT HOURS:3-0-0
CORRESPONDING LAB COURSE CODE (IF ANY): BTPS102-18	LAB COURSE NAME:PPS - LAB

<b>MODULE</b>	<b>DETAILS</b>	<b>HOURS</b>
1.	Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of algorithm Flowchart/ Pseudo code with examples. Syntax and logical errors in compilation	8
2.	Introduction about constants, variables, data types, operators, precedence and expressions. Evaluation of conditional Branching and loops.	14
3.	1-D and 2-D Arrays, Character Array and strings.	6
4.	Searching, Sorting algorithms (Bubble, insertion and selection) quick sort and merge sort.	6
5.	Functions, Parameter passing in functions, call by value and call by reference, passing array to functions.	6
6.	Recursion Recursion, as a different pointers, Use of Pointers in self-referential structures, notion of linked list	5
7.	Defining structures and Array of structures	4
8.	Idea of pointers ,Use of pointers in structure.	2
6.	Introduction, File reading/writing in different modes	3

**Total hours –52**

**TEXT/REFERENCE BOOKS:**

S.No	BOOK TITLE/AUTHORS/PUBLICATION
1.	"The Programming Language" ,Braian W. Kernighan and Desnnis M. Ritchie.
2.	"Let Us C",By Yashwant Kanetkar, Saurav Kulkarni.
3.	"C Programming Language", A step by step beginners guide to learn C programming by Darel L Graham.
4.	"Programming in C", by Reema Thareja
5.	"C in Depth",by Deepali Srivastava and S K Srivastava.
6.	Computer Programming using C language – Vipran Arora, Eagle's Publications.

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Small Group Instruction.
- Making real world connections
- Presentations

**E- CONTENT USED:**

- <https://www.youtube.com/watch?v=8PopR3x-VMY>
- <https://www.youtube.com/watch?v=3lqgdqoY83o>
- <https://www.youtube.com/watch?v=08LWytp6PNI>

**ADDITIONAL TOPICS:**

- Object Oriented Programming Concepts
- Use of Class in OOPS
- Use of Inheritance
- Introduction about N/w Security
- Introduction about Web Technology

**COURSE OBJECTIVES:**

The aim and objective of the course on English is to introduce the students of B. Tech. class to the formal structure of English so that they can use these in Engineering as per their requirement.

**COURSE OUTCOMES:**

<b>Course: PPS</b>		
<b>Subject Code- BTPS101-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
<b>1.</b>	Explore the working of program development, characteristics of C, compilation process, Flowchart and it's working.	1
<b>2.</b>	Explain the use of different data types, operators, expressions, Input / Output statements, Library Functions.	2
<b>3.</b>	Run programs based on control statements like if-else, if-else-if, for loop, while loop, do-while loop, Switch statement and break statement.	3
<b>4.</b>	Identify the use of functions (Call by value, call by reference), parameter passing in functions, Passing array to functions, Categorize sorting algorithms (Bubble, Insertion and Selection)	4
<b>5.</b>	Order of complexity through Programs, Use of array (1-d Array & 2-d Array), Relate the use of structures, Array of structures, Use of pointer in C	4
<b>6.</b>	Describe Strings, reading & writing strings, standard library string functions, Study of reading from a file, writing to a file, structure of file program, Error handling in file and command line arguments in file.	6

**CO MAPPING WITH PO:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	1	2	1	1	-		-	-	-	-	-	2	1	1	1
<b>CO2</b>	2	1-	-	-	3	-	2	-	-	1	-	1	-	2	
<b>CO3</b>	1	-	-	2	2	-	3	-	-	-	-	3	2	1	
<b>CO4</b>	3	-	3	2	2	-	-	-	-	-	3	2	-	2	
<b>CO5</b>	2	3	-	2	2	-	-	-	-	-	-	3	3	2	1
<b>CO6</b>	2	-	3	-	3	-	1	-	-	-	1	1	-	2	

**BTSP102-18****COURSE INFORMATION SHEET**

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE: PPS Lab	SEMESTER-2 CREDITS-2
COURSE CODE- BTSP102-18 Year of Introduction – 2018	COURSE TYPE – CORE
COURSE AREA/DOMAIN- PPS	CONTACT HOURS:0-0-4
CORRESPONDING LAB COURSE CODE (IF ANY): NA	

**List Of Practicals:**

S.No	DETAILS	HOURS
1.	Familiarization with programming environment	3
2.	Simple computational problems using arithmetic expressions	4
3.	Problems involving if-then-else structures.	2
4.	Iterative Problems	1
5.	1D Array manipulation	2
6.	Matrix problems, String operations	2
7.	Simple functions	1
8.	Pointers and structures	2
9.	File handling	3

**TEXT/REFERENCE BOOKS:**

S.No	BOOK TITLE/AUTHORS/PUBLICATION
1.	"The Programming Language" ,Braian W. Kernighan and Desnnis M. Ritchie.
2.	"Let Us C",By Yashwant Kanetkar, Saurav Kulkarni.
3.	"C Programming Language", A step by step beginners guide to learn C programming by Darel L Graham.
4.	"Programming in C", by Reema Thareja
5.	"C in Depth",by Deepali Srivastava and S K Srivastava.
6.	Computer Programming using C language – Vipin Arora, Eagle's Publications.





## WORKSHOP/MANUFACTURING PRACTICES

### COURSE INFORMATION SHEET

<b>PROGRAMME: ELECTRICAL ENGINEERING</b>	<b>DEGREE: BTECH</b>
<b>COURSE: WORKSHOP/MANUFACTURING PRACTICES</b>	<b>SEMESTER: 1 CREDITS: 3</b>
<b>COURSECODE: BTMP101-18</b> <b>REGULATION: 2018</b>	<b>COURSE TYPE: CORE</b>
<b>COURSE AREA/DOMAIN:</b>	<b>CONTACT HOURS: 1(L) + 4(P) hours/Week.</b>

### SYLLABUS:

UNIT	DETAILS	HOURS
	<b>THEORY</b>	
<b>I</b>	Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods	<b>3</b>
<b>II</b>	CNC machining, Additive manufacturing	<b>1</b>
<b>III</b>	Fitting operations & power tools	<b>1</b>
<b>IV</b>	Electrical & Electronics	<b>1</b>
<b>V</b>	Carpentry	<b>1</b>
<b>VI</b>	Plastic moulding, glass cutting	<b>1</b>
<b>VII</b>	Metal casting	<b>1</b>
<b>VIII</b>	Welding (arc welding & gas welding), brazing	<b>1</b>
	<b>WORKSHOP PRACTICE</b>	
<b>I</b>	Machine shop	<b>10</b>
<b>II</b>	Fitting shop	<b>8</b>
<b>III</b>	Carpentry	<b>6</b>
<b>IV</b>	Electrical & Electronics	<b>8</b>
<b>V</b>	Welding shop (Arc welding 4 hrs + gas welding 4 hrs )	<b>8</b>
<b>VI</b>	Casting	<b>8</b>
<b>VII</b>	Smithy	<b>6</b>
<b>VII</b>	Plastic moulding & Glass Cutting	<b>6</b>

**TEXT/REFERENCE BOOKS:**

S.NO	BOOK TITLE/AUTHORS/PUBLICATION
1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “ Elements of Workshop Technology” , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. And Steven S. Schmid, “ Manufacturing Engineering and Technology” , 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu,” Manufacturing Technology – I” Pearson Education, 2008.
4	Roy A. Lindberg, “ Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
5	Rao P.N., “ Manufacturing Technology” , Vol. I and Vol. II, Tata McGrawHill House, 2017.

T/R	BOOK TITLE SUGGESTED BY FACULTY
1	B.S Raghuvanshi, A course in Workshop Technology, Dhanpat Rai & Co.
2	R S Khurmi,J K Gupta, Textbook of Workshop Technology, S Chand
3	O P Khanna, Production Technology Manufacturing Processes, Dhanpat Rai Publications.

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Small Group Instruction.
- Making real world connections
- Presentatons

**E- CONTENT USED:**

- NPTEL Notes and videos

**ADDITIONAL TOPICS:**

- Sheet Metal: Shop development of surfaces of various objects; sheet metal forming and joining operations, joints, soldering and brazing; exercises involving use of sheet metal forming operations for small joints.
- Foundry Shop: Introduction to molding materials; moulds; use of cores; melting furnaces; tools and equipment used in foundry shops; firing of a cupola furnace; exercises involving preparation of small sand moulds and castings

**COURSE OBJECTIVES:**

1. Upon completion of this course, students will be able to fabricate components with their own hands.
2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. By assembling different components, they will be able to produce small devices of their interest.

**COURSE PRE-REQUISITES:**

C.CODE	COURSE NAME	DESCRIPTION	SEM

**PROGRAMME SPECIFIC OUTCOMES:**

S.NO	DESCRIPTION
PSO1	Graduates will be able to specify structure and breakdown frameworks that productively create, transmit, appropriate and use electrical force.
PSO2	Graduates will be able to apply present day programming devices for plan, recreation and investigation of electrical frameworks to participate in long lasting learning and to effectively adjust in multi-disciplinary situations.
PSO3	Graduates will be able to generate, effective transmission and dissemination of electric power with unique reference to non-conventional and sustainable power source assets.

**COURSE OUTCOMES:**

S.NO	DESCRIPTION	BT Level
CO1	Define different manufacturing process commonly employed in the industry to fabricate components using different materials.	1
CO2	Explain the mechanisms of metal cutting and chip formation in machining and distinguish between various process of casting and welding technology.	2
CO3	Understand CNC Machining and different additive manufacturing techniques.	2
CO4	Demonstrate practical knowledge of dimensional accuracies and dimensional tolerances possible with different manufacturing processes.	3
CO5	Apply the skills of basic electrical engineering for house wiring practice and illustrate the working of electronic components and its utilization	3
CO6	By assembling different components, they will be able to produce small devices of their interest and fabricate components with their own hands.	6

**CO –PO-PSO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO1
CO1	3	2		-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	-	2	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	1	-	-	-	-	-	-	-	1	1	2	2
CO6	1	2	3	-	-	-	-	1	-	2	-	-	1	-	-

## COURSE INFORMATION SHEET

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE: ENGLISH	SEMESTER-1 CREDITS-4
COURSE CODE- BTHU101-18 Year of introduction – 2018	COURSE TYPE – CORE
COURSE AREA/DOMAIN- ENGLISH	CONTACT HOURS: 3-1-0
CORRESPONDING LAB COURSE CODE (IF ANY): BTHU102-18	LAB COURSE NAME: ENGLISH- LAB

## SYLLABUS:

MODULE	DETAILS	HOURS
I	<p><b>Vocabulary Building &amp; Basic Writing Skills</b></p> <p>The concept of Word Formation</p> <ul style="list-style-type: none"> <li>• Root words from foreign languages and their use in English</li> <li>• Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.</li> <li>• Sentence Structures</li> <li>• Use of phrases and clauses in sentences</li> <li>• Importance of proper punctuation</li> <li>• Creating coherence</li> <li>• Organizing principles of paragraphs in documents</li> <li>• Techniques for writing precisely</li> </ul>	4
II	<p><b>Identifying Common Errors in Writing</b></p> <p>Subject-verb agreement</p> <ul style="list-style-type: none"> <li>• Noun-pronoun agreement</li> <li>• Misplaced modifiers</li> <li>• Articles</li> <li>• Prepositions</li> <li>• Redundancies</li> <li>• Clichés</li> </ul>	6
III	<p><b>Mechanics of Writing</b></p> <p>Writing introduction and conclusion</p> <ul style="list-style-type: none"> <li>• Describing</li> <li>• Defining</li> <li>• Classifying</li> <li>• Providing examples or evidence</li> </ul>	4
IV	<p><b>Writing Practices</b></p> <p>Comprehension</p> <ul style="list-style-type: none"> <li>• Précis Writing</li> <li>• Essay Writing</li> <li>• Business Writing-Business letters, Business Emails, Report Writing, Resume/CV</li> </ul>	4

**Total hours – 42**

**TEXT/REFERENCE BOOKS:**

S.No	BOOK TITLE/AUTHORS/PUBLICATION
1.	Practical English Usage. Michael Swan. OUP. 1995.
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
3.	On Writing Well. William Zinsser. Harper Resource Book. 2001
4.	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006
5.	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

	BOOK TITLE SUGGESTED BY FACULTY
1	Oxford modern English grammar by B. Aarts
2	English Grammar by Michael swan

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Group Discussion.
- Projector
- Presentations

**E- CONTENT USED:**

- <https://www.youtube.com/watch?v=zfbUzWqsH74>

**COURSE OBJECTIVES:**

The aim and objective of the course on English is to introduce the students of B. Tech. class to the formal structure of English so that they can use these in Engineering as per their requirement.

**COURSE OUTCOMES:**

<b>Course: ENGLISH</b>		
<b>Subject Code- BTHU-101-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
<b>1</b>	Choose basic proficiency in listening and speaking skills.	1
<b>2</b>	Interpret the independent user of English language.	2
<b>3</b>	Make use of communication training.	3
<b>4</b>	Discover different strategy of effective communication and select the most appropriate mode of communication for a given situation.	4
<b>5</b>	Distinguish effectively and assertively.	4
<b>6</b>	Combine effectively through different mode of written communication.	6

**CO MAPPING WITH PO:**

<b>CO's</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	2		3				2		3		2			
<b>CO2</b>	1	3		2		1			2	2					
<b>CO3</b>			3			2		2	3	3		2			
<b>CO4</b>	1	3				2			1	2		1			
<b>CO5</b>	2					3			2	1	3	2			
<b>CO6</b>	3		2	2				1	1			2			

## ENGLISH LAB

## COURSE INFORMATION SHEET

PROGRAMME: ENGINEERING	DEGREE: B.TECH
COURSE: ENGLISH	SEMESTER-2 CREDITS-4
COURSE CODE- BTHU102-18 Year of introduction – 2021	COURSE TYPE - CORE
COURSE AREA/DOMAIN- ENGLISH	CONTACT HOURS: 0(L)-0(T)-2(P)
CORRESPONDING LAB COURSE CODE (IF ANY): BTHU102-18	LAB COURSE NAME: ENGLISH- LAB

SYLLABUS:

MODULE	DETAILS
I	Listening Comprehension
II	Self-Introduction, Group Discussion and Role Play
III	Common Everyday Situations: Conversations and Dialogues
IV	Communication at Workplace
V	Interviews
VI	Formal Presentations

**Total hours – 42**

TEXT/REFERENCE BOOKS:

S.No	BOOK TITLE/AUTHORS/PUBLICATION
1.	(i) Practical English Usage. Michael Swan. OUP. 1995.
2.	(ii) Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3.	(iii) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

T/R	BOOK TITLE SUGGESTED BY FACULTY
1	Oxford modern English grammar by B. Aarts
2	English Grammar by Michael swan



**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Group Discussion.
- Projector
- Presentations

**E- CONTENT USED:**

- [https://www.youtube.com/watch?v=JuBAXrPGiXg&list=RDOMjCpImeiKYJo&start\\_radio=1](https://www.youtube.com/watch?v=JuBAXrPGiXg&list=RDOMjCpImeiKYJo&start_radio=1)

**COURSE OBJECTIVES:**

The aim and objective of the course on English Lab is to introduce the students of B. Tech. class to the formal structure of English Lab so that they can use these in Engineering as per their requirement.

**COURSE OUTCOMES**

<b>Course: ENGLISH</b>		
<b>Subject Code- BTHU-102-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
<b>CO1</b>	Recall the content of audio inputs for effective listening skills.	1
<b>CO2</b>	Demonstrate the physiological characteristics of proper voice and diction for better speaking skills.	2
<b>CO3</b>	Practice the worksheets related to stress and intonation on words for better fluency in language.	3
<b>CO4</b>	Analyze everyday situations through role play activities for better presentation in corporate sector and daily life.	4
<b>CO5</b>	Illustrate interview skills through mock interview practices.	4
<b>CO6</b>	Implement Listening, Speaking, Reading and Writing skills through formal presentation	6

**CO MAPPING WITH PO**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>1.</b>								1	3	3		3		
<b>2.</b>								2	3	2		2		
<b>3.</b>								2	2	3		2		
<b>4.</b>								1	3	3		3		
<b>5.</b>								1	2	2		2		
<b>6.</b>								2	2	2		2		

## 2<sup>ND</sup> SEMESTER

### INDEX

**SCHEME: B.TECH 2nd SEMESTER**

**(ELECTRICAL ENGINEERING)**

**I.K. Gujral Punjab Technical University Revised Scheme for B.Tech Syllabus 2018**

Slot	Course No.	Subject	L-T-P	Hours	Credits
A	BTPH102-18	Optics and Modern Physics	3-1-0	4	4
B	BTPH112-18	Optics and Modern Physics Lab	0-0-3	3	1.5
C	BTAM202-18	Mathematics-II	3-1-0	4	4
D	BTEE101-18	Basic Electrical Engineering	3-1-0	4	4
E	BTEE102-18	Basic Electrical Engineering (Lab)	0-0-2	2	1
F	BTME101-21	Engineering Graphics & Design	1-0-5	5	3
G	BMPD201-18	Mentoring and Professional Development	0-0-2	2	0

**Total Credits = 17.5**

**Hours: 25**

## COURSE INFORMATION SHEET

<b>PROGRAMME: ENGINEERING</b>	<b>DEGREE: BTECH</b>
<b>COURSE: OPTICS AND MODERN PHYSICS</b>	<b>SEMESTER: 2 CREDITS: 4</b>
<b>COURSE CODE: BTPH-102-18</b> <b>REGULATION: 2018</b>	<b>COURSE TYPE: CORE</b>
<b>COURSE AREA/DOMAIN: OPTICS AND MODERN PHYSICS</b>	<b>CONTACT HOURS: 3(L) + 1 (T) hours/Week.</b>
<b>CORRESPONDING LAB COURSE CODE : BTPH-112-18</b>	<b>LAB COURSE NAME: : OPTICS AND MODERN PHYSICS LAB</b>

SYLLABUS:

<b>UNIT</b>	<b>DETAILS</b>	<b>HOURS</b>
<b>I</b>	<b><u>Waves and Oscillations</u></b> Mechanical simple harmonic oscillators, damped harmonic oscillator, forced mechanical oscillators, impedance, steady state motion of forced damped harmonic oscillator, Transverse wave on a string, wave equation on a string, reflection and transmission of waves at a boundary, impedance matching, standing waves, longitudinal waves and their wave equation, reflection and transmission of waves at a boundary.	<b>10</b>
<b>II</b>	<b><u>Optics and LASERS</u></b> Optics: Light as an electromagnetic wave, reflectance and transmittance, Fresnel equations (Qualitative idea), Brewster's angle, total internal reflection; Interference: Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Michelson interferometer. Diffraction: Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power; LASERS: Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), and its applications.	<b>10</b>
<b>III</b>	<b><u>Introduction to Quantum Mechanics</u></b> Wave nature of Particles, Free-particle wave function and wave-packets, probability densities, Expectation values, Uncertainty principle, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, Solution of stationary-state Schrodinger equation for one dimensional problems: particle in a box, linear harmonic oscillator	<b>10</b>
<b>IV</b>	<b><u>Introduction to Solids and Semiconductors</u></b> Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Origin of energy bands (Qualitative idea); Types of electronic materials: metals, semiconductors, and insulators, Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction.	<b>10</b>

**TEXT/REFERENCE BOOKS:**

<b>T/R</b>	<b>BOOK TITLE/AUTHORS/PUBLICATION</b>
1	I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2	H. J. Pain, "The physics of vibrations and waves", Wiley, 2006
3	A. Ghatak, "Optics", McGraw Hill Education, 2012
4	HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill, 2018

<b>T/R</b>	<b>BOOK TITLE SUGGESTED BY FACULTY</b>
1	D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
2	S. Sharma and J. Sharma, Engineering Physics, Pearson, 2018.

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

Chalk & Talk

Small Group Instruction.

Making real world connections

Inquiry-based Learning

**E- CONTENT USED:**

<https://youtu.be/I1TBV421ar4>

<https://youtu.be/Q-oQKSLhLKw>

**ADDITIONAL TOPICS:**

Basics of ray optics

Basics of classical theory and its drawbacks

Photoelectric equation

**COURSE OBJECTIVES:**

The aim and objective of the course on Optics and Modern Physics is to introduce the students of B.Tech. to the subjects of wave optics, Quantum Mechanics, Solids, and Semiconductors so that they can use these in Engineering as per their requirement.

**COURSE OUTCOMES:**

S.NO	DESCRIPTION	BT LEVEL
1	Demonstrate understanding of the distinction between mechanical simple harmonic oscillator, damped harmonic oscillator and forced damped harmonic oscillator with the steady state motion.	B.L -1 B.L -4
2	Classify the basic fundamentals of optics and LASERS.	B.L -1 B.L -3
3	Interpret the differential wave equation for the standing waves and longitudinal waves.	B.L-3 B.L-4
4	Analyze the value of need for quantum mechanics, Schrödinger equation, uncertainty principle etc and their various applications.	B.L -1 B.L- 5
5	Formulate & construct engineering problems in optics and modern Physics.	B.L -1 B.L -3
6	Discuss basic idea of doping , p-n junction diode and its V-I characteristics using graphical and mathematical methods	B.L -1 B.L -6

**CO MAPPING WITH PO**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	1	-	-	-	1	-	-	1	-	-	2	1	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	1		1					1	-	-	-
CO5	1	-	-	-	-	-	-	-	2	-	-	1	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-

**OPTICS AND MODERN PHYSICS LAB:**

<b>PROGRAMME: ENGINEERING</b>	<b>DEGREE: BTECH</b>
<b>COURSE AREA/DOMAIN: OPTICS AND MODREN PHYSICS</b>	<b>CONTACT HOURS: 0-0-3 hours/Week.</b>
<b>CORRESPONDING LAB COURSE CODE : BTPH-112-18</b>	<b>LAB COURSE NAME: : OPTICS AND MODREN PHYSICS LAB</b>

**SYLLABUS:**

<b>SECTION-A</b>
1. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
2. Study of diffraction using laser beam and thus to determine the grating element.
3. To study laser interference using Michelson's Interferometer.
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To determine attenuation & propagation losses in optical fibres.
6. To determine the grain size of a material using optical microscope.
7. To find the refractive index of a material/glass using spectrometer.
8. To find the refractive index of a liquid using spectrometer..
9. To find the velocity of ultrasound in liquid.
10. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.
11. To study the characteristic of different p-n junction diode - Ge and Si
. 12. To analyze the suitability of a given Zener diode as voltage regulator.
13. To find out the intensity response of a solar cell/Photo diode.
14. To find out the intensity response of a LED.
15. To find out the frequency of AC mains using electric-vibrator
<b>SECTION-B</b>
1. To find the resolving power of the prism.
2. To determine the angle of the given prism..
3. To determine the refractive index of the material of a prism
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.
13. To plot a graph connecting photocurrent and applied potential.
14. To determine the stopping potential from the photocurrent versus applied potential graph

**TEXT/REFERENCE BOOKS:**

S.NO	BOOK TITLE/AUTHORS/PUBLICATION
1	A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11 th Edn, 2011, Kitab Mahal
2	Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd
3	Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.

S.NO	BOOK TITLE SUGGESTED BY FACULTY
1	Practical Physics, C L Arora, S. Chand & Company Ltd

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- First-Hand Experience In Observation
- Making Real World Connections
- Implement Peer-Instruction.

**COURSE OBJECTIVES:**

The aim and objective of the lab on Optics and Modern Physics lab is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in their branch of Engineering as per their requirement

**COURSE PRE-REQUISITES:**

C.CODE	COURSE NAME	DESCRIPTION	SEM
BTPH-104-18	Higher secondary Education	Introduction to Optics and Modern Physics Lab	1 & 2

**COURSE OUTCOMES:**

S.NO	DESCRIPTION	BT Level (B.L)
1	Understand, explain and use instrumental techniques for intensity pattern analysis	B.L -1 B.L -4
2	Understand and apply the concept of Interference of light, Diffraction of light, Fermi energy and magnetic effect of current.	B.L -1 B.L -3
3	Examine the methods used for estimating and dealing with experimental uncertainties and systematic errors.	B.L-3 B.L-4
4	Apply and demonstrate the theoretical concepts of Engineering Physics.	B.L -1 B.L- 3
5	Apply the theoretical concepts of laser, numerical aperture and photo detectors.	B.L -1 B.L -3
6	Understand and use the principles of operations of optical fibers and semiconductor devices using simple circuits.	B.L -1 B.L -6

**CO MAPPING WITH PO:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1								1						
CO2	2		1	1								1			
CO3		1										1			
CO4	1			1								2			
CO5	1					1						1			
CO6	1					2						2			



## MATHEMATICS -II

### COURSE INFORMATION SHEET

<b>PROGRAMME: ENGINEERING</b>	<b>DEGREE: BTECH</b>
<b>COURSE: MATHEMATICS-II</b>	<b>SEMESTER: 2                      CREDITS: 4</b>
<b>COURSE CODE:BTAM-202-18</b> <b>REGULATION: 2021</b>	<b>COURSE TYPE: CORE</b>
<b>COURSE AREA/DOMAIN:Mathematics</b>	<b>CONTACT HOURS: 4(L) + 1 (T) hours/Week.</b>
<b>CORRESPONDING LAB COURSE CODE : NIL</b>	<b>LAB COURSE NAME:NA</b>

### SYLLABUS:

<b>UNIT</b>	<b>DETAILS</b>	<b>HOURS</b>
<b>I</b>	<b><u>Ordinary Differential Equations</u></b> First and higher order Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Power series solutions.	<b>13</b>
<b>II</b>	<b><u>Partial Differential Equations</u></b> First order First order partial differential equations, solutions of first order linear and non-linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Separation of variables method to simple problems.	<b>12</b>
<b>III</b>	<b>Numerical Methods-I</b> Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	<b>12</b>
<b>IV</b>	<b>Numerical Methods-II</b> Ordinary differential equations: Taylor's series, Euler and modified Euler's methods; RungeKutta method of fourth order for solving first and second order equations. Milne's and Adam's predictor-corrector methods. Partial differential equations: Finite difference solution of twodimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.	<b>13</b>

**Total hours – 50**

### TEXT/REFERENCE BOOKS:

<b>T/R</b>	<b>BOOK TITLE/AUTHORS/PUBLICATION</b>
<b>1.</b>	W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
<b>2.</b>	S. L. Ross, "Differential Equations", Wiley India, 1984.
<b>3.</b>	E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
<b>4.</b>	E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
<b>5.</b>	G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007
<b>6.</b>	N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.

	<b>BOOK TITLE SUGGESTED BY FACULTY</b>
1	S. L. Ross, "Differential Equations", Wiley India, 1984.
2	N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Small Group Instruction.
- Making real world connections
- Inquiry-based Learning

**E- CONTENT USED:**

- [https://youtu.be/3j0c\\_FhOt5U](https://youtu.be/3j0c_FhOt5U)
- <https://youtu.be/eTp5wq-cSXY>

**ADDITIONAL TOPICS:**

- Linear Equations with Variable Coefficients
- Boundary value problem
- Polynomial interpolation

**COURSE OBJECTIVES:**

The objective of this course is to familiarize the prospective engineers with techniques in linear algebra, transform calculus and numerical methods. It aims to equip the students with standard concepts and tools of integral transforms, matrices and numerical techniques that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

**COURSE OUTCOMES:**

<b>Course: MATHEMATICS PAPER-II</b>		
<b>Course Code: BTAM202-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
<b>1</b>	Demonstrate the basic theory of linear ODEs and basic types of higher-order linear ODEs for which exact solutions may be obtained	2
<b>2</b>	Apply the fundamental concepts of partial differential equations to study the vibration of a string, flow of heat in a rod and plate (steady state).	3
<b>3</b>	Examine the common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.	4
<b>4</b>	simplify numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	4
<b>5</b>	Evaluate different implicit and explicit methods for heat and wave equations.	5
<b>6</b>	Explain the concept of various methods to solve nth order differential equations.	5

**CO MAPPING WITH PO:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	3										2			
<b>CO2</b>	2	2	1	1								2			
<b>CO3</b>	3	2										1			
<b>CO4</b>	2	2	2	2								2			
<b>CO5</b>	3	3										1			
<b>CO6</b>	2	3			1							2			

**BASIC ELECTRICAL ENGINEERING  
COURSE INFORMATION SHEET**

PROGRAMME: B.Tech	
COURSE: Basic Electrical Engineering	SEMESTER: 2 <sup>nd</sup> CREDITS: 05
COURSE CODE: BTEE-101-18	COURSE TYPE: Regular
COURSE AREA/ DOMAIN: Basic Electrical	CONTACT HOURS: L T P 3 1 2
CORRESPONDING LAB CODE: BTEE102-18	LAB COURSE NAME: Basic Electrical Engineering Laboratory

**Course plan:**

UNIT	DETAILS	HOURS
1	<b>Module 1: DC Circuits</b> Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin's and Norton's Theorems. Time-domain analysis of first-order RL and RC circuits.	9
2	<b>Module 2: AC Circuits</b> Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations series resonance. Parallel resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.	13
3	<b>Module 3: Electrical Machines</b> Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	12
4	<b>Module 4: Electrical Installations</b> Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	5
<b>TOTAL HOURS</b>		39

**TEXT/ REFERENCE BOOKS:**

T/R	BOOK TITLE/ AUTHORS/ PUBLICATION
T1	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010
T2	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
R1	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011
R2	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010
R3	V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989

T/R	BOOK TITLE SUGGESTED BY FACULTY
1	S.K Sehdev by Unique Publisher
2	J.B gupta by S. Chand Publisher

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

Chalk & Talk

Small Group Instruction.

Making real world connections

Presentatons

**RECOMMENDED NPTEL/ MOOCS/SWAYAM COURSES/ VIDEOS**

<https://www.coursera.org/learn/electric-power-systems> (Electric Power System)

<https://www.youtube.com/watch?v=U3CubKnkO4c> (Transformer 3D Animation )

<https://www.youtube.com/watch?v=DsVbaKZZOFQ> (three phase induction motor working)

<https://www.youtube.com/watch?v=tiKH48EMgKE&list=PLZY3yNTgIlyWtOLxT19ZIAK9zIgPK3H9d> (working of alternator)

<https://www.youtube.com/watch?v=gW45N2WpD64> (working of DC generator)

<https://www.youtube.com/watch?v=QkbnOga09Vg> (flip flops)

Web Source References:

1	<a href="https://nptel.ac.in/courses/108108076/">https://nptel.ac.in/courses/108108076/</a> (1-39) (Covering Transformer, Machines, power factor etc.)
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**ADDITIONAL TOPICS:**

Providing knowledge about generation, transmission, distribution

Providing additional knowledge on protection of electrical machines, drives and power system

**COURSE OBJECTIVES:**

Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.

Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.

To explain the working principle, construction, applications of DC machines, AC machines & the importance of transformers in transmission and distribution of electric power.

To Gain knowledge about the fundamentals of LT components of switchgear, wiring and earthing

**COURSE OUTCOMES:**

<b>Course: BASIC ELECTRICAL ENGINEERING</b>		
<b>Course Code: BTEE-101-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
1.	Understand & apply Kirchoff's laws, network theorems, time domain analysis for RL & RC series circuit.	2
2.	Understand and analyse phasor diagram and waveforms for purely resistive, purely inductive and purely capacitive as well as series and parallel R-L, R-C & R-L-C circuits and also circuit Resonance	3
3.	Understand concepts of Real, Reactive & apparent power and Power factor. Understand 3- phase supply and star and delta connection and their relationships. Power measurement by wattmeter	4
4.	Understand construction & working principle of 1- phase and 3- phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	4
5.	Understand generation of rotating magnetic fields. Understand construction and working of 3-phase induction motor, 1-phase induction motor, DC motors & synchronous generators	5
6.	Understand LT Switchgear such as Switch Fuse Unit (SFU), MCB, ELCB, MCCB. Understand about wires, cables, earthing & its importance. Understand about types of batteries & its important Characteristics. Understand basic calculations for energy consumption & power factor improvement	5

**CO MAPPING WITH PO:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			1							2			
CO2	3	1			1							2		1	1
CO3	3	1			1							2			1
CO4	1		1									2			
CO5	2		1									1			
CO6	2		1			1						2			

**COURSE INFORMATION SHEET  
BASIC ELECTRICAL ENGINEERING LAB**

**List of experiments/demonstrations:**

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstrate of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

**COURSE OUTCOMES:**

<b>BASIC OF ELECTRICAL ENGINEERING LAB</b>		
<b>Course Code: BTEE102-18</b>		
	<b>Course Outcomes</b>	<b>BT Level</b>
1.	Apply KCL, KVL and ohms law to Simple circuits.	1
2.	Determine the self conductance of the coil	2
3.	Performing the operation & tests of transformer and rotating machines	3
4.	Analyse the differences in operation of different DC machine configurations.	4
5.	Experimentally verify the basic circuit theorems	5
6.	Measure power and power factor in ac circuits	6

**CO MAPPING WITH PO:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
CO1	2	1			1							1		1	1
CO2	2	1			1							1		1	
CO3	2	1			1							1			1
CO4	1		1									1	1	1	
CO5	1		1									1		1	1
CO6	2		1			1						1		1	

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- First-Hand Experience In Observation
- Making Real World Connections
- Implement Peer-Instruction.



## ENGINEERING GRAPHICS AND DESIGN

### COURSE INFORMATION SHEET

<b>PROGRAMME: ELECTRICAL ENGINEERING</b>	<b>DEGREE: BTECH</b>
<b>COURSE: ENGINEERING GRAPHICS AND DESIGN (THEORY &amp; LAB)</b>	<b>SEMESTER: 1 CREDITS: 3</b>
<b>COURSECODE: BTME101-21</b> <b>REGULATION: 2021</b>	<b>COURSE TYPE: CORE</b>
<b>COURSE AREA/DOMAIN: ENGINEERING DRAWING</b>	<b>CONTACT HOURS: 1(L) + 5(P) hours/Week.</b>

### SYLLABUS:

UNIT	DETAILS	HOURS
<b>I</b>	<b>INTRODUCTION TO ENGINEERING DRAWING:</b> Principles of engineering drawing / engineering graphics / technical drawing and their significance –Drawing Instruments: their Standard and uses – symbols and conventions in drawing practice – lettering & numbering – BIS conventions. Types of lines and their uses, Drawing Sheets: sizes and layout, methods of folding drawing sheet, Grades of pencils used, Dimensioning: definition, types and methods of dimensioning, geometrical construction, concept of scales in drawing, types of scales, construction of plane and diagonal scales	<b>18</b>
<b>II</b>	<b>ORTHOGRAPHIC PROJECTIONS:</b> Relevance of projection, Types of projections, Principles of orthographic projections in reference to quadrants – conventions – first and third angle projections, illustration through simple problems of projection; Projections of points in quadrants. Projections and trace of a line with different possible orientations in a quadrant. Methods to find true length and inclination of a line with principal planes.	<b>12</b>
<b>III</b>	<b>PROJECTIONS OF PLANES AND SOLIDS:</b> Concept of plane and lamina, Projections of a lamina when; parallel to any reference plane, perpendicular to any reference plane, inclined to reference plane. Traces of planes. Definition of solid, types of solids – conventions-different possible orientations of solid in a quadrant. Projections of solid when; axis parallel to reference plane, perpendicular to reference plane, inclined to one and parallel to other reference plane, parallel to both horizontal and vertical planes.	<b>18</b>
<b>IV</b>	<b>ISOMETRIC PROJECTIONS:</b> Principles of Isometric Projections-Isometric Scale- Isometric Views or drawing- Conventions. Isometric drawing / projections of solids such as cube, prisms, pyramids, cylinder, and cone.	<b>12</b>
<b>V</b>	<b>Practice using Computer Aided Drafting (CAD) tools:</b> Hands on training on any CAD software to strengthen the understanding of the engineering drawing wherein the students will be introduced to a number of assignments as mentioned in the syllabus.	<b>12</b>

**TEXT/REFERENCE BOOKS:**

S.NO	BOOK TITLE/AUTHORS/PUBLICATION
1	Engineering Drawing- Basant Agarwal, TMH
2	D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi.
3	P.S Gill, "Engineering Drawing", S K Kataria and sons, 18th edition, 2017 reprint
4	Jolhe, Dhananjay (2006), Engineering Drawing: With an Introduction to CAD, Tata Mc Graw Hill, India.
5	N. D. Bhat (2006), Engineering Drawing, Charotar Publications, New Delhi.
6	Venugopal (2010), Engineering Drawing and Graphics, 2nd edition, New Age Publications, New Delhi
7	Trymbaka Murthy (2007), Computer Aided Engineering Drawing, I.K. International Publishers, New Delhi.
8	R.B. Choudary (2005), Engineering graphics with Auto CAD, Anuradha Publishers, New Delhi

T/R	BOOK TITLE SUGGESTED BY FACULTY
1	Harwinder Singh, Engineering Drawing and Computer Graphics , Dhanpat Rai Publishing Co.
2	R.K Dhawan, Text Book of Engineering Drawing, S Chand Publication.

**DELIVERY/INSTRUCTIONAL METHODOLOGIES/ TEACHING PEDAGOGY:**

- Chalk & Talk
- Small Group Instruction.
- Making real world connections
- Presentatons

**E- content used:**

- <https://archive.nptel.ac.in/courses/112/102/112102304/>

**ADDITIONAL TOPICS:**

- Intersection of Surfaces/Solids
  - Purpose of intersection of surfaces, Intersection between the two cylinder, two prisms, prism and pyramid, pyramid and pyramid, cylinder and prism, cone and cylinder, sphere and cylinder etc., use of cutting plane and line method.
- Development of Surface
  - Purpose of development, Parallel line, radial line and triangulation method. Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, and development of surface of sphere.

**COURSE OBJECTIVES:**

1. To understand the basic principles of engineering drawing
2. To have the knowledge of generating the pictorial views

3. To understand the development of surfaces
4. Use CAD tools for making drawings of machine components and assemblies.
5. To have the knowledge of interpretation of dimensions of different quadrant projections.

**COURSE PRE-REQUISITES:**

C.CODE	COURSE NAME	DESCRIPTION	SEM

**COURSE OUTCOMES:**

S.NO	DESCRIPTION	Bloom's Level (B.L)
CO1	Prepare and understand drawings	B.L -1
CO2	Use the principles of orthographic projections.	B.L -3
CO3	By studying about projections of solids, students will be able to visualize three dimensional objects and that will enable them to design new products.	B.L-2 B.L -3
CO4	Design and fabricate surfaces of different shapes.	B.L- 6
CO5	Apply Computer-aided design (CAD) software to modeling of parts and assemblies, dimensions, and annotations to drawing.	B.L -3
CO6	Represent and create the objects in three dimensional appearances.	B.L -1 B.L -6

**PROGRAMME SPECIFIC OUTCOMES:**

S.NO	DESCRIPTION
PSO1	Graduates will be able to specify structure and breakdown frameworks that productively create, transmit, appropriate and use electrical force.
PSO2	Graduates will be able to apply present day programming devices for plan, recreation and investigation of electrical frameworks to participate in long lasting learning and to effectively adjust in multi-disciplinary situations.
PSO3	Graduates will be able to generate, effective transmission and dissemination of electric power with unique reference to non-conventional and sustainable power source assets.

**CO –PO-PSO MAPPING**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<b>CO2</b>	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
<b>CO3</b>	-	3	3	3	-	-	-	-	-	-	-	3	1	1	-
<b>CO4</b>	-	-	2	-	-	-	-	-	-	2	-	-	-	-	1
<b>CO5</b>	-	-	-	-	-	-	-	-	3	3	-	3	-	-	1
<b>CO6</b>	-	-	-	-	3	-	-	-	-	-	-	3	-	-	1

