DEPARTMENT OF ELECTRONICS ENGINEERING

ELECTRONICS ENGINEERING PROGRAMME

(SANDWICH PATTERN)

CURRICULUM DOCUMENT (REVISION 2019)

(Fourth Semester)

GOVERNMENT POLYTECHNIC MUMBAI

(An Autonomous Institute, Government of Maharashtra)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme(P19)

With effect from AY 2019-20

Programme: Diploma in Electronics Engineering (Sandwich Pattern) **Term / Semester - IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
EC19403	Control Systems	4	2	0	6	6	60	20	20	0	50	50	200
EC19303	Power Electronics	4	4	0	8	8	60	20	20	50*	0	25	175
MG19501	EDP And Management	3	0	0	3	3	60@	20@	20@	0	0	0	100
SC19112	Applied Mathematics	1	0	2	3	3	0	0	0	0	0	50	50
EC19404	Computer Network	3	2	0	5	5	0	0	0	0	50	50	100
EC19405	Elective1 Fiber optic Communication	4	2	0	6	6	60	20	20	50*	0	25	175
EC19406	Elective 1 Mobile Communication												
EC19407	PYTHON 3.4.3 (MOOC)	**0**	4	0	4	4	0	0	0	0	0	0	0
	Total	**19**	**14**	**2**	**35**	**35**	**240**	**80**	**80**	**100**	**100**	**200**	**800**
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test ,**#** indicates Self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour , TH- 2 hours, PR/OR – 3 hours per batch , SCA- Library - 1 hour, Sports- 2 hours, Creative Activity-2 hours

Self, on- line learning Mode through MOOCs /Spoken Tutorials / NPTEL / SWAYAM / FOSSEE etc.

Department Co-Ordinator
Curriculum Development,
Department of Electronic

Head of Department
Department of Electronics,

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19403**				Course Title: **Control System**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30mins)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**2**	**-**	**6**	**60**	**20**	**20**	**-**	**50**	**50**	**200**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) * Indicates assessment by External Examiner else internal practical skill test # indicates Self, on- line learning Mode, @ indicates on line examination.

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

A control system consists of several elements or components connected and operated in such a way as to achieve a desired control in a specific domain of operation of the system. To increase the effectiveness, efficiency and quality of products, now a days it is very much essential to complete the required work or task automatically in every field. Control systems are also used in space technology and defense applications such as nuclear power weapons, guided missiles etc. As the control system is the basis of various automatic control systems, therefore the students of electronic engineering must have the knowledge of control system.

Course Outcomes: Student should be able to

CO1	Identify various types of control systems.
CO2	Understand time and frequency domain specifications
CO3	Determine stability conditions of control system.
CO4	Select appropriate Control system component and control action as necessary.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Overview of Control system** 1.1 System – definition and practical examples Control system – definition and Examples. 1.2 Classification of control system.

	1.3 Open loop and closed loop systems – definition, block diagram, practical example and Comparison. 1.4 Transfer function – definition, derivation of transfer function for close loop control system. Transfer function of simple RC and RLC circuits. 1.5 S-plane representation: 1.6 Poles and zeros: Definition and simple numerical 1.7 Order of a system – definition, 0^{th}, 1^{st}, 2^{nd} order system standard equation, practical examples. 1.8 Linear time varying and time in varying systems –definition and example. 1.9 Block diagram representation of a system-Reduction rules, problems (only SISO). **Course Outcome: CO1 Teaching Hours:12 hrs Marks: 10 (R-04, U-04, A-02)**
2	**Time Domain Analysis** 2.1 Standard test inputs: Step, ramp, parabolic and impulse, significance, and corresponding Laplace representation. 2.2 Time domain analysis: Transient and steady state response. 2.3 First order control system: Analysis for unit step input, Concept of time constant. 2.4 Second order control system: Analysis for unit step input, Concept, definition and effect of damping. 2.5 Time response specifications (no derivations) Tp, Ts, Tr, Td, Mp. Simple numerical on time response specifications. 2.6 Steady state analysis: Type 0, 1, 2 systems, 2.6.1 Error constants 2.6.2 Steady state error 2.6.3 Simple numerical **Course Outcome:CO2 Teaching Hours:12 hrs Marks: 14 (R-04, U-04, A-06)**
3	**Frequency domain Analysis** 3.1 Introduction, advantages and disadvantages of frequency response analysis and frequency domain 3.2 Frequency response specifications. 3.3 Correlation between time and frequency domain specifications. 3.4 Realization of Lead, Lag, Lead-Lag Compensator. **Course Outcome: CO2 Teaching Hours: 06 hrs Marks: 08 (R-02, U-06, A-0)**
4	**Stability** 4.1 S-plane – Introduction. 4.2 Definition of stability 4.3 Necessary Conditions for stability. 4.4 Types of stability- stable, unstable, critically stable and conditionally stable system, relative stability. 4.5 Routh's stability criterion- different cases and conditions and simple numerical 4.6 Bode plot - introduction, Definition of Phase Margin and Gain Margin. 4.7 Introduction of Root Locus (No Numerical)

	Course Outcome: CO3 Teaching Hours:12 hrs Marks: 10 (R- 02, U-04, A-04)
5	**Servo Systems** 5.1 Servo system – definition, block diagram. 5.2 Servo components: 5.2.1 Potentiometer as error detector. 5.2.2 Synchro as Transmitter and Error detector. 5.2.3 Rotary encoder. 5.3 Armature controlled DC servo motor. 5.4 Field controlled DC servo motor. **Course Outcome: CO4 Teaching Hours: 8 hrs Marks:08 (R-02, U-04, A-02)**
6	**Control Actions:** 6.1. Process control system: Block diagram and explanation of each block. 6.2. Control actions 6.2.1 Discontinuous modes: ON OFF controllers: equation, neutral zone 6.2.2 Continuous modes: PROPORTIONAL controllers (offset, Proportional Band), INTEGRAL and DERIVATIVE controllers; o/p equations, corresponding Laplace Transforms, Response of P, I and D controllers. 6.3 Composite controllers: PI, PD, PID controllers- Block diagram, O/P Equations, Response, Comparison. 6.4 Electronic P, I, D, PI, PD, PID controller: only circuit diagram using OPAMP **Course Outcome: CO4 Teaching Hours: 10 hrs Marks:10 (R-02, U-04, A-04)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Overview of Control system**	04	04	02	10
2	**Time Domain Analysis**	04	04	06	14
3	**Frequency domain Analysis**	02	06	--	08
4	**Stability**	02	04	04	10
5	**Servo Systems**	02	04	02	08
6	**Control Actions**	02	04	04	10
	Total	**16**	**26**	**18**	**60**

List of experiments: Total 10 experiments (or turns) out of 15 experiments (or turns)

Sr. No.	Unit No	Cos	Title of the Experiments	Hours
1	1	CO1	Demonstrate the performance of open loop control system using electronic amplifiers- Op Amps.	2
2	1	CO1	Demonstrate the performance of closed loop control system using electronic amplifiers- Op Amps.	2
3	2	CO2	Plot unit step response of given first-order system and find out its time constant.	2
4	3, 6	CO3, CO4	A case study on – Determine Stability of given control system using Rouths Criteria / Case study on: Demonstration of PID controller for temperature/level control using any software / any topic suggested by faculty. (Actual work on case study etc.)	2
5	3, 6	CO3, CO4	A case study on – Determine Stability of given control system using Rouths Criteria / Case study on: Demonstration of PID controller for temperature/level control using any software / any topic suggested by faculty. (Case study report writing etc)	2
6	5	CO4	Measurement of error using Potentiometer error detector.	2
7	1	CO1	Determine the transfer function for given closed loop system in block diagram representation.	2
8	2	CO2	Plot unit step response of given second-order system.	2
9	2	CO2	Determine the steady-state errors for Type-0,1 and 2 systems for different standard inputs.	2
10	3	CO2	Plot the Phase margin and Gain Margin of a given system Using Bode Plot.	2
11	5	CO4	Demonstration of Synchro transmitter receiver system.	2
12	6	CO4	Demonstration of temperature/level control with ON-OFF controller.	2
13	6	CO4	Demonstration of temperature/level control with PI controller.	2
14	2	CO2	Mini Project: Simulate and test the performance of 1st order RC and 2^{nd} order RLC circuit using any simulation software / any topic suggested by faculty. (execute actual project with the help of software etc)	2
15	2	CO2	Mini Project: Simulate and test the performance of 1st order RC and 2^{nd} order RLC circuit using any simulation software / any topic suggested by faculty. (mini project report preparation etc)	2
		Total		30

Note: Experiments No. 1 to 6, 14 and 15 are compulsory and should map all units and Cos.
Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Control system Engg.	J.J.Nagrath & M. Gopal,Tata McGraw-Hill	9781848290037
2	Process Control Instrumentation Technology	C.D. Johnson, PHI	9789332549456
3	Modern control Engg.	K. Ogata ,PHI	978812034010
4	Control systems	A. Kumar,Tata McGraw-Hill	9788120331976
5	Principles of Control systems	Goyal and Bakshi,Technical Publication	9788189411596

E-Reference

1.www.nptlvideos.com/control_sysrtems

2.www.in.mathworks.com/solutions/control_system.html?s_tid=srchtitle

3. All : https://www.youtube.com/watch?v=o_Bp7j77Uqc&list=PLWPirh4EWFpGpH_Rb6Q4iQ6vGGRA6MORZ&index=2

4. All: https://www.youtube.com/playlist?list=PLgwJf8NK-2e43et6qbo4IqYSJCv-6kN90

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	--	--	2	1	2	--
CO2	2	2	2	1	--	2	3	2	3	2
CO3	3	3	3	2	1	2	3	3	2	3
CO4	2	3	3	2	1	3	3	3	1	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Gavand Uttam	Dy. Manager	JSW Dolvi, Pen, Raigad
2	Ms. J.J.Mane	Lecturer in Electronics	Govt. Polytechnic Pen
3	Ms. A.N.Sayyed	Lecturer in Electronics	P. L. Govt. Polytechnic, Latur
4	Ms. T.K.Balsaraf	Lecturer in Electronics	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Electronics Engineering

Head of Department
Department of Electronics Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19303**				Course Title: **Power Electronics**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**4**	**-**	**8**	**60**	**20**	**20**	**50***	**-**	**25**	**175**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

It is necessary for the students to study and apply the basic principles, analyse and troubleshoot simple circuits like controlled rectifier, light dimmer, battery charger etc. To acquire this level of understanding, the basic knowledge of power semiconductor devices and circuit is essential. This Course is one of the core subject which is deals with construction, working principle, application of power semiconductor devices as well as it deals with some sophisticated power electronics systems and complex circuits such as choppers, inverters etc.

Course Outcomes: Student should be able to

CO1	Identify power electronics devices in circuits.
CO2	Maintain turn ON and turn OFF circuit and protection circuit of SCR
CO3	Understand the concept of single phase and three phase controlled rectifier.
CO4	Use choppers and inverters in different application
CO5	Identify and select appropriate thyristor and related devices for various Industrial Electronics applications.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Power Semiconductor devices:** 1.1 SCR introduction 1.1.1 Construction, symbol, working principle and V-I characteristics. 1.1.2 Transistorized equivalent circuit of SCR. 1.1.3 Specifications of SCR. 1.1.4 Definitions: Holding current, latching current, firing angles, conduction angle and break over voltage. 1.1.5 Applications of SCR

	1.2 Thyristor Family Devices: Construction, symbol, working principle, V-I characteristics and application 1.2.1 TRIAC 1.2.2 Power MOSFET 1.2.3 IGBT 1.3 Triggering Devices: Construction, symbol, working principle, V-I characteristics and application. 1.3.1 DIAC 1.3.2 UJT **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**SCR Turn ON, Protection circuits and SCR Turn OFF methods** 2.1 SCR turn on methods. 2.2 Gate trigger circuits: Circuit diagram, working principle, waveforms. 2.2.1 Resistance triggering circuit 2.2.2 R-C triggering circuit 2.2.3 UJT triggering using pulse transformer 2.3 Series and parallel connection of SCRs 2.3.1 Need for equalizing network 2.3.2 AC and DC equalizing circuits 2.3.3 Definition of String efficiency, Derating. 2.4 Protection circuits: Circuit diagram, working principle. 2.4.1 over voltage 2.4.2 over current 2.4.3 dv/dt protection 2.4.4 di/dt protection 2.5 Natural commutation: circuit diagram & working principle 2.6 Forced commutation: circuit diagram & working principle. 2.6.1 Type A 2.6.2 Type B 2.6.3 Type C 2.6.4 Type D 2.6.5 Type E **Course Outcome: CO2 Teaching Hours : 13 hrs Marks: 12 (R-6, U-6, A-2)**
3	**Controlled Rectifier** 3.1 Single-phase half wave controlled rectifiers with resistive load, inductive load (with and without freewheeling diode): Circuit diagram, working principle, waveforms. 3.2 Single-phase full wave (bridge configurations) controlled rectifiers with resistive load and inductive load (with and without freewheeling diode): Circuit diagram, working principle, waveforms. 3.2.1 Effect of freewheeling diodes 3.3 Three-phase half wave controlled rectifier with resistive load: Circuit diagram, working principle, waveforms

	Course Outcome: CO3 Teaching Hours : 8 hrs Marks: 8 (R-2, U-4, A-2)
4	**Chopper** 4.1 Introduction, classification, basic chopper circuit diagram and working. 4.2 Types of chopper: Circuit diagram, working principle and waveforms 4.2.1 Step up chopper (Boost converter) using SCR. 4.2.2 Step down chopper (Buck converter) using SCR. 4.2.3 First quadrant or class A chopper. 4.2.4 Second quadrant or class B chopper. 4.2.5 Two quadrant Type A or class C chopper. 4.2.6 Two quadrant Type B or class D chopper. 4.2.7 Four quadrant chopper or class E chopper. 4.3 Other chopper circuit : circuit diagram and working principle 4.3.1 Buck-Boost converter using MOSFET. **Course Outcome: CO4 Teaching Hours : 9 hrs Marks: 10 (R- 4 , U- 4 , A-2)**
5	**Inverter** 5.1 Introduction. Classification of inverters according to nature of input source, method of commutation, connection of thyristor and commutating component. 5.2 Types of inverters: Working principle and operation 5.2.1 Series inverter 5.2.2 Parallel inverter 5.3 Single phase SCR bridge Inverter : Circuit diagram , working principle and waveforms 5.3.1 1Ø half bridge inverter 5.3.2 1Ø Full bridge inverter 5.4 McMurray Bedford half Bridge Inverter: Circuit diagram, working principle and waveforms. 5.5 Applications. **Course Outcome: CO4 Teaching Hours : 8 hrs Marks: 8 (R- 2, U- 4, A-2)**
6	**Industrial applications of Power Electronic devices** 6.1 Switched Mode power Supply (SMPS): Classification, Basic SMPS block diagram and working. 6.1.1 Working of Modified block diagram of SMPS 6.1.2 Advantages and Disadvantages of SMPS 6.2 Uninterruptible Power Supply (UPS): Need and block diagram of UPS system. 6.3 Types of UPS system: Block diagram and operation 6.3.1 On-line UPS 6.3.2 Off-line UPS 6.3.3 Line interactive UPS 6.4 Industrial Circuits: Circuit diagram and working principle 6.4.1 Light dimmer using TRIAC 6.4.2 Battery charger using SCR

	6.4.3 Emergency Lighting System 6.5 Speed control of DC motor: Circuit diagram and working principle 6.5.1 Field flux control 6.5.2 Armature Voltage control 6.6 Speed control of Induction motor: Circuit diagram and working principle 6.6.1 Variable frequency control **Course Outcome: CO5 Teaching Hours : 12 hrs Marks: 12 (R-4, U-8, A-)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Power Semiconductor devices**	4	4	2	10
2	**SCR Turn ON, Protection circuits and SCR Turn OFF methods**	4	6	2	12
3	**Controlled Rectifier**	2	4	2	8
4	**Chopper**	4	4	2	10
5	**Inverter**	2	4	2	8
6	**Industrial applications of Power Electronic devices**	4	8	0	12
	Total	**20**	**30**	**10**	**60**

List of experiments: Total 12 experiments out of 15 experiments

Sr. No.	Unit No	Cos	Title of the Experiments	Hours
1	1	CO1	A. Verify the V-I characteristics of SCR. B. Verify the V-I characteristic of TRIAC	4
2	2	CO2	Observe firing angle control of SCR using R triggering method.	4
3	3	CO3	Observe the waveform of half wave controlled rectifier for variable firing angle.	4
4	4	CO4	Test waveforms at various points of step up chopper using SCR	4
5	6	CO5	Test light dimmer circuit using TRIAC	4
6	5	CO4	Trace the series inverter circuit and list the major components of the circuit, sketch the observed waveforms and measure voltage levels.	4
7	1	CO1	A. Verify the V-I characteristic of power MOSFET. B. Verify the V-I characteristic of DIAC.	4

8	2	CO2	Observe firing angle control of SCR using RC triggering method.	4
9	3	CO3	Observe the waveform of full wave controlled rectifier for variable firing angle	4
10	4	CO4	Test waveforms at various points of step down chopper using SCR	4
11	5	CO4	Trace the parallel inverter circuit and list the major components of the circuit, sketch the observed waveforms and measure voltage levels.	4
12	6	CO5	Test Battery charger circuit using SCR	4
13	2	CO2	Observe the output waveforms of relaxation oscillator using UJT	4
14	2	CO2	Case study on protection circuit of SCR	4
15	1,2,3 ,4,5, 6	CO1,2 ,3,4,5	Mini project: Group of two students should prepare PCB with tested circuit mounted on it for any Industrial electronics application circuit. For example. SCR flasher, Emergency lighting system and/or any circuit from practical list.	4
Total				**60**

Note: Experiments No. 1 to 5, 14 and 15 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Power electronics	M. D. Singh & K.B. khanchandani, Mcgraw-hill publishing, 2nd edition 1998	978-0070583894
2	Industrial & power electronics	Harish rai, umesh publication, 1/e edition 2018	978-9386827869
3	Power electronics	P. S. Bimbhra, Khanna publishers; 5th edition 1990	978-8174092793
4	Power electronics	Munammad h. Rashid, Pearson Education., 3nd edition , 2014	978-9332535770

E-References:

1. https://ndl.iitkgp.ac.in/
2. www.scribd.com
3. https://nptel.ac.in/courses/
4. www.youtube.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	1	3		1	1	2	1	1
CO2	2	1	1	1	1	1	1	2	2	1

CO3	2	1	2	1	1	1	2	2	2	1
CO4	1	1	2	3	2	2	1	2	2	2
CO5	3	3	3	3	3	2	2	3	3	2

Industry Consultation Committee:

Sr. No	**Name**	**Designation**	**Institute/Organisation**
1	Mr. Pankaj Badgujar	Asst. Engineer	Autometer Alliance Ltd.
2	Mrs. M. R. Chavhan	Lecturer	Govt. Polytechnic Vikramgad
3	Ms. A. A. Sangale	Lecturer	Govt. Polytechnic Awasari
4	Mrs. A. M. Ghadge (Curriculum Content Designer)	Lecturer	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____

Head of Department
Department of _____

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: MG19501				Course Title: **Entrepreneurship Development And Management**						
Compulsory / Optional: compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (1Hrs)	TS1 (30 min)	TS2 (30 min)	PR	OR	TW	Total
3	**-**	**-**	**3**	**60@**	**20@**	**20@**	**-**	-	**-**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rationale: Diploma pass out students are normally placed at the supervisory level when they go to industries. Where they are expected to handle labour, material and machinery to get the targeted output. This requires knowledge of managing different resources of the organizations effectively. Entrepreneur puts up new projects that create wealth and opens up many employment opportunities. This course deals with different aspects of management, which helps technician to manage the changed environment in the industry.

Course Outcomes: Student should be able to

CO1	Understand the basic concept of entrepreneurial process , scope and various support systems to entrepreneur.
CO2	Understand the different levels and process of management.
CO3	Describe forms of ownership, Human Resource Management and industrial safety rules.
CO4	Manage different industrial resources efficiently.
CO5	Apply various rules and regulations concerned with Business.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Entrepreneurship** 1.1. Definition of entrepreneurship 1.2. Characteristics of entrepreneurship 1.3. Functions of entrepreneurship 1.4. Barriers of entrepreneurship 1.5. Distinction of entrepreneur and Manager **Course Outcome: CO1 Teaching Hours : 5 Marks: 8 (R- 4 U-4, A- -)**
2	**Scope and Support Systems** 2.1. Trading, Consultancy, Franchises, Service Sectors, Emerging Areas 2.2 Small Enterprises 2.2.1. Definition, Characteristics & Types 2.2.2. Problems Faced by SSI

	2.2.3. Industrial Sickness- Causes & Corrective Measures 2.3. Functions & Supportive Institutes (MSME, SIDBI, DICS, SSIB, NSIC, MITCON, TCO's, MIDC) 2.4. Government Agencies **Course Outcome: CO1 Teaching Hours : 6 Marks: 8 (R-2 , U- 2 , A- 4)**
3	**Overview Of Business Management Process** 3.1 Definition of Business, 3.2 Types of Business- Service, Manufacturing & Trades 3.3 Management- Various Definitions 3.4. Levels of Management 3.5. Basic Functions of Management- Planning, Organizing, Staffing, Directing & Controlling 3.6. Fourteen Principles of Management **Course Outcome: CO2 Teaching Hours : 6 Marks: 10 (R- 2 , U- 6 , A-2)**
4	**Organizational and HR Management** 4.1. Organization- Definition 4.2 Forms of Ownership, Proprietorship, Partnership, Joint Stock Company, Co-Operative Society, Government Sector 4.3 Personnel Management- Definition & Functions. 4.4 Financial Management : Objective, functions, Capital generation: Types and Source of capital **Course Outcome: CO3 Teaching Hours : 6 Marks: 10 (R- 2 , U- 8 , A- 0)**
5	**Industrial Safety and Management** 5.1. Causes of Accident 5.2. Safety Precautions 5.3. Introduction To: 5.3.1. Factory Act 1948 5.3.2. Workmen Compensation Act 5.3.3. Goods And Services Tax **Course Outcome: CO3 Teaching Hours : 6 Marks: 8 (R- 2 , U- 4, A- 2)**
6	**Materials Management** 6.1. Inventory Management: Definition of Inventory and inventory Control. Objectives of Inventory Control 6.2. ABC Analysis, Graphical Representation 6.3. Economic Order Quantity (E.O.Q.) 6.3.1. Graphical Representation 6.3.2 Calculation of E,O.Q. **Course Outcome: CO4 Teaching Hours : 7 Marks: 6 (R- - , U-4 , A- 2)**
7	**Project Management** 7.1. Project Management: Definition And Meaning of Project 7.2 Overview of Project Management Methodologies viz. Water Fall, Agile, Hybrid, Critical Path Method, Critical Chain Method, Integrated Project Management, PRISM, PRINCE - 2 7.3. Introduction to C.P.M & P.E.R.T, Preparation Of Network, Calculation of Project Duration And Floats 7.4. Concept oF Break Even Analysis 7.5. Project Risk and Quality Management: Qualitative and Quantitative Analysis of Risks and Quality, Risk Index Risk Management, Quality Management. 7.6 Concept of KAIZEN, 5 "S". 7.7 Advantages and Applications of KAIZEN, 5 "S". **Course Outcome: CO5 Teaching Hours : 9 Marks: 10 (R- 2 , U-4 , A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to entrepreneurship**	4	4	-	8
2	**Scope and Support Systems**	2	2	4	8
3	**Overview Of Business Management Process**	2	6	2	10
4	**Organizational and HR Management**	2	8	0	10
5	**Industrial Safety and Management**	2	4	2	8
6	**Materials Management**	-	4	2	6
7	**Project Management**	2	4	4	10
	Total	**14**	**32**	**14**	**60**

.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Industrial Engineering and Management	Dr .O.P. Khanna , Dhanpal Rai & Sons., New Delhi	ISBN: 9788189928353, 9788189928353
2	Industrial Management	Rustom S. Davar, Khanna publication	0800212436, 9780800212438
3	Industrial Management	Jhamb & Bokil , Everest Publication ,Pune.	8176602043 978-8176602044
4	Organization & Management	R. D .Agarwal , Tata M'graw hill	0-07-451596-3

E-References:

1. https://ndl.iitkgp.ac.in/ 2.www. scribd.com
3. www.slideshare.net.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	1	-	1	2	2	1	-	-
CO2	2	2	1	-	2	2	2	1	-	-
CO3	3	3	2	2	1	2	2	1	-	-
CO4	1	2	1	-	1	2	2	1	-	-
CO5	2	3	2	1	2	3	2	1	-	-

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Sandeep Dongare	Director	HCL
2	Ms. Vishakhka Pawar	Lecturer	Govt. Polytechnic,vikramgadh
3	Mr. N.N.Ansari	Lecture	Govt. Polytechnic Mumbai
4	Mrs .A. D. Kalyankar	Lecturer	Govt. Polytechnic Mumbai Electonics Dept.

Coordinator,
Curriculum Development,
Department of Electronics

Head of Department
Department of Electronics

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **SC19112**				Course Title: **APPLIED MATHEMATICS**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2 Hrs 30 Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
1	**--**	**2**	**3**				**--**	---	**50**	**50**

Abbreviations: TH- Theory; PR-Practical; TU-Tutorial; TS1 and TS2- Term Tests; OR-Oral Exam; TW: Term Work (progressive assessment), * Indicates assessment by External Examiner else internal assessment

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

This subject is classified under the foundation courses group and proceeds further to application level of mathematics to teach students the theory,concepts ,principles of applied mathematics and the application, importance and use of mathematics in the analysis of concepts in electronics.

Course Outcomes: Student should be able to

CO1	Solve first order first degree differential equations of various types
CO2	Apply differential equation for solving problems in electronics engineering field.
CO3	Apply laplace transform to solve differential equation of first order with constant coefficients

Course Content Details:

Unit No	Topics / Sub-topics
1	**1.Differential Equations** 1.1 Definition of Differential Equation 1.2 Order and Degree of Differential Equation 1.3 Formation of Differential equation for function containing single constant 1.4 Solution of first order first degree differential equation 1.4.1 Variable separable

	1.4.2 Equation reducible to variable separable form 1.4.3 Homogeneous D.E. 1.4.4 Exact D.E. 1.4.5 linear D.E. **Course Outcome: CO1 Teaching Hours : 06 hrs Marks : 20 (R- 8, U-6, A-6)**
2	**2.Application of Differential equation** 2.1 For solution of simple geometrical cases. 2.2 For solution of simple electrical/electronic circuits: LC ,RC, RLC. **Course Outcome: CO2 Teaching Hours : 03 hrs Marks: 10 (R- 4 , U-2 , A-4)**
3	**3. Laplace Transformation** 3.1 Definition 3.2 Laplace transform of elementary functions 3.3 Important properties of Laplace Transform 3.3.1 Linearity property 3.3.2 First shifting property 3.3.3 Second shifting property 3.3.4.change of scale property 3.4 Important results-multiplication by t^n and division by t (without proof) 3.5 Inverse Laplace Transform 3.6 Properties of Inverse Laplace transform 3.6.1 Linearity Property 3.6.2 First shifting Property 3.7 Inverse laplace transform by partial fraction 3.8 Application of laplace transform for solving differential equations of first order with costant coefficients **Course Outcome: CO3 Teaching Hours : 06 hrs Marks: 20 (R-8 , U- 6 , A-6)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Differential Equations**	8	6	6	20
2	**Application of Differential equation**	4	2	4	10
3	**Laplace Transformation**	8	6	6	20
	Total	**20**	**14**	**16**	**50**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering Mathematics	Ravish R Singh,Mukul Bhatt McGraw Hill	13-9780070146150 10-0070146150
2	Mathematics for Polytechnic Students (Volume I)	H.K.Dass, S.Chand Prakashan	9788121935241
3	Companions to Basic Maths	G.V.Kumbhojkar, Phadke Prakashan	10-B07951HJDQ 13-B07951HJDQ
4	Applied Mathematics	N.Raghvendra Bhatt late, Tata McGraw Hill Publication Shri R Mohan Singh	9789339219567, 9339219562

E-References:

1. www.math-magic.com
2. www.Scilab.org/-SCI Lab
3. www.mathworks.com/Products/Matlab/-MATLAB
4. www.wolfram.com/mathematica/-Mathematica
5. https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig
6. www.dplot.com/-Dplot
7. www.allmathcad.com/-Math CAD
8. www.easycalculation.com
9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping (ELECTRONICS ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2			1				1	1
CO2	3	2			1				1	1
CO3	3	1			1				1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr.Venugopal Adep	Technical Delivery Manager	TIAA, Godrej one, 11 Floor South Zone , Eastern Express Hwy , Vikhroli,Mumbai 400079
2	Mr.Santosh Bhandekar	Lecturer in Mathematics	Government Polytechnic, Solapur
3	Mr. A.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai
4	Mr.V.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai

Coordinator, Curriculum Development, Department of Sci. & Humanities

Head of Departments Department of Sci. & Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19404**				Course Title: **Computer Network**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**-**	**-**	**-**	**-**	**50**	**50**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rationale:

This course introduces students to communication networks and concentrates on building a firm foundation of it. Students will study data communication concepts and techniques in layered network architecture (OSI reference model, TCP/IP networking architecture).

This course provides the fundamental knowledge of the various aspects of computer networking.

Course Outcomes: Student should be able to

CO1	Classify the different network types
CO2	Identify the different types of network topologies and protocols
CO3	Enumerate the layers of the OSI/ISO model
CO4	Illustrate different multiplexing and switching techniques
CO5	Demonstrate the functions of different network components and devices

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Networks:** 1.1 Brief history: Voice networks to data networks 1.2 Definition of network, Need of data communication Network 1.3 Network Architecture: Workstation, Host, Client, Server 1.4 Basic Network Types: Classification according to area 1.4.1 Local Area Network (LAN) 1.4.2 Wireless LAN (WLAN) 1.4.3 Wide Area Networks (WANs) 1.4.4 Variants (CANs, MANs and PANs) 1.4.5 VPN, MAN, Peer to peer, Client/server 1.5 Networks, Sub networks and Inter-networks

	1.6 The Internet, Intranets and Extra-nets **Course Outcome: CO1 Teaching Hours: 09**
2	**Introduction to Transmission Technologies:** 2.1 Network Physical Topologies: 2.1.1 Bus 2.1.2 Star 2.1.3 Ring 2.1.4 Mesh 2.1.5 Point-to-point 2.1.6 Point-to-multipoint 2.1.7 Hybrid 2.2 Transmission modes, circuit types and services: 2.2.1 Transmission modes Connection types: Simplex, Half Duplex, Full Duplex 2.2.2 Multidrop circuits 2.2.3 Private lines and Local loops 2.3 Private leased line versus Switched network **Course Outcome: CO2 Teaching Hours: 10**
3	**The Open Systems Interconnection OSI/ISO models:** 3.1 Need of OSI/ISO model 3.2 Function of each layer of the OSI model 3.2.1 Layer 1 – Physical, 3.2.2 Layer 2 – Data link, 3.2.3 Layer 3 – Network, 3.2.4 Layer 4 – Transport, 3.2.5 Layer 5 – Session, 3.2.6 Layer 6 – Presentation, 3.2.7 Layer 7 – application 3.3 List of protocols at each layer 3.4 TCP/IP model and Description **Course Outcome: CO3 Teaching Hours: 09**
4	**Multiplexing and Switching Technology:** 4.1 Definition of Multiplexing 4.2 Types of multiplexing: FDM, TDM, CDM 4.3 Comparison 4.4 Switching techniques: 4.4.1 Circuit switching 4.4.2 Message switching 4.4.3 Packet switching 4.5 Connector Types: Definition and Specification 4.5.1 RJ-11, RJ-45 4.5.2 BNC 4.5.3 RS-232 4.6 Wiring Standards: 4.6.1 Straight-through cable (586A)

	4.6.2 Crossover cable (586B) **Course Outcome: CO4 Teaching Hours: 8**
5	**Different network Components and devices:** 5.1 Network Components: 5.1.1 Repeater 5.1.2 Switch 5.1.3 Router 5.1.4 Hub 5.1.5 Bridge 5.1.6 Gateway 5.1.7 Modem 5.1.8 NIC 5.1.9 Media converters 5.1.10 Wireless access point 5.1.11 Firewall 5.1.12 DHCP server 5.2 Functions of specialized network devices: 5.2.1 Multilayer switch, Content switch. 5.2.2 Intrusion detection and Prevention system 5.2.3 Load balancer 5.2.4 Multifunction network devices 5.2.5 DNS server 5.2.6 Bandwidth shaper 5.2.7 Proxy server 5.2.8 Channel or data service unit 5.3 Private branch exchange 5.4 Comparison between Routing switching and bridging **Course Outcome: CO5 Teaching Hours: 09**

List of experiments: Total 10 experiments (for 1 turn) out of 15 experiments

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Study of different Networking Tools like Network and Telecom Crimping Tool / LAN Cable Tester / Line Tester.	02
2	2	CO2	Identify the different types of network topologies.	02
3	3	CO3	Familiarize with different Categories of Ethernet: Ethernet, Fast Ethernet, Gigabit Ethernet, 10G Ethernet. (Specification and Comparison)	02
4	4	CO4	Study different types of network cables.	02
5	5	CO5	To install devices like Printer / Router /Access Points	02
6	1	CO1	Implement Basic Network Commands	02
7	3	CO2	To configure IP addressing and sub netting concept	02
8	2	CO4	To configure LAN network using CAT5/6 cable and RJ 45 jack outlet Crimping	02

9	5	CO5	To connect and transfer files between multiple PC's using networking switch	02
10	5	CO4	To check connection using ping command and use of IP configuration command	02
11	4	CO1	To make cross-wired and straight cables using crimping tools	02
12	1	CO2	To study network troubleshooting techniques and commands including ping, tracert, netsh, ipconfig, and netstat etc.	02
13	5	CO3	To study sharing network devices (wired or wireless)	02
14	5	CO5	Make a Mini project by using different Network Components.	02
15	3	CO3	Do Case study on any one Network service provider company on their Network infrastructure and design	02
Total				**30**

Note: Experiments No. 1 to 5, 14 and 15 are compulsory and should map all units and COs, Also experiment number 16 and 17 is compulsory. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Data communication	Behroz Forouzen, Tata Mc Graw Hill. 5th edition	ISBN13:9780073376226
2	Computer network	Tanenbaum, Pearson	ISBN13:9788131787571
3	Data & Computer Communications	William Stallings, Pearson	ISBN13:9789332518865
4	CCNA reference book	Online	

E-References:

1. https://ndl.iitkgp.ac.in
2. https://www.netacad.com/courses/networking
3. https://www.youtube.com

CO vs PO and CO vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	3	2	2	1	1	3	3	2
CO2	1	1	2	1	2	2	2	3	2	2
CO3	3	1	0	1	2	2	2	2	3	3
CO4	2	1	1	1	2	2	3	1	3	2
CO5	2	1	2	1	2	3	2	2	2	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Ms Nikita Dorlikar	Manager	Jetking
2	Ms Khushbu Sathwane	Lecturer in Computer	Govt. Polytechnic, Pune
3	Ms Shweta Sisodiya (Curriculum designer)	Lecturer in Electronics	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Electronics

Head of Department
Department of Electronics

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19405**				Course Title: **Fiber Optic Communication**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30 min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**2**	**-**	**6**	**60**	**20**	**20**	**50***	-	**25**	**175**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 and TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rationale:

Optical fiber based communication networks have become major information transmission system with high capacity links encircling the globe in both terrestrial and under-sea installation. Numerous passive and active optical devices within these links perform complex transmission and networking functions in the optical domain such as signal amplification, restoration, multiplexing, switching and routing etc. Knowledge of optical fiber technology is helpful in understanding of optical communication system, optical sources and detectors, various losses, optical links and related components.

Course Outcomes: Student should be able to:

CO1	Classify different types of Optical Fibres, its structure and components.
CO2	Describe and use different splicing techniques and connectors.
CO3	Understand different losses and attenuation in fiber optics.
CO4	Describe various sources and detectors used in FOC.
CO5	Explain multiplexing techniques in fiber optics.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Theory of Optics and Fundamentals of Optical Fiber** 1.1 Optical spectrum: Band name and its range 1.2 Fiber optics communication 1.2.1 Introduction 1.2.2 Advantages and disadvantages 1.2.3 Applications 1.3 Block diagram and working of Fiber Optic communication system. 1.4 Definition and concept of reflection, refraction, dispersion, diffraction, absorption and scattering with the help of light theory. 1.5 Ray theory transmission: Total internal reflection, Definition of critical angle,

	Acceptance angle, Numerical Aperture. **Course Outcome: CO1 Teaching Hours: 10 Marks: 08 (R- 4, U-4, A-)**
2	**Optical fiber Structure and Components** 2.1 Types of Fibers 2.2.1 Mono mode Step index 2.2.2 Multimode Step index 2.2.3 Multimode Graded index fiber 2.2 Components**:** Diagram and Function 2.2.1 Directional Couplers 2.2.2 Isolators 2.2.3 Circulators 2.2.4 Multiplexers 2.2.5 Filters 2.3 Types and Function of Optical Amplifiers, Switches and wavelength convertors. **Course Outcome: CO1 Teaching Hours :10 Marks:08 (R-2, U-4, A-2)**
3	**Signal Degradation in Optical Fibers** 3.1 Losses 3.1.1Typical Attenuation graph of standard fiber and its interpretation 3.1.2 Absorption mechanism 3.1.3 Scattering mechanism 3.1.4 Bending losses and its types 3.1.5 Core and cladding losses. 3.2 Signal Distortion in optical wave guides: Various dispersion mechanisms, group and phase delay concepts, bandwidth-distance product concept, cut off wavelength. **Course Outcome: CO3 Teaching Hours : 08 Marks:10 (R- 4, U- 6, A-)**
4	**Optical Sources and Detectors** 4.1 Concept of absorption, spontaneous emission and stimulated emission. 4.2 Concept of Heterojunction structure, concept of quantum efficiency. 4.2 LED: Diagram and working principle 4.2.1 Surface emitter LED . 4.2.2 Edge emitter LED 4.3 Laser Diodes: Diagram and working principle 4.3.1 Fabry - Parot resonator 4.3.2 Distributed feedback resonator (DBF) 4.3.3 Advantages of Laser 4.4 Photodetector: Diagram and working principle, advantages and applications 4.4.1 P-N photo diode 4.4.2 P-I-N photo diode. **Course Outcome: CO4 Teaching Hours :12 Marks:12 (R-4, U- 6, A- 2)**
5	**Power Launching and Coupling** 5.1 Source to fiber Launching. 5.2 Lensing schemes for coupling improvement: Fiber Misalignments, Fiber-to-fiber joints. 5.3 Fiber splicing methods**:** Diagram and working principle 5.3.1 Fusion splicing method 5.5.2 V-groove splicing method

	5.5.3 Elastic tube splicing method 5.4 Fiber connectors: Requirements of a good connector design, Types and Applications. 5.5 Attenuation measurements**:** OTDR block diagram and working principle. **Course Outcome: CO2 Teaching Hours :10 Marks: 10 (R- 2, U- 6, A- 2)**
6	**Multiplexing in Fiber Optic Communication** 6.1 Introduction to SONET and SDH. 6.1.1 SONET/SDH Rings: Diagram and working principle of i. Two fiber UPSR ii. Two fiber BLSR 6.2 Wavelength Division Multiplexing. 6.2.1 Definition and Necessity of WDM. 6.2.2 Advantages of WDM. 6.2.3 Block diagram and operational principles of WDM. 6.3 DWDM deployment of multiple wavelengths: Block diagram and working principle. 6.4 Link Power Budget: Block diagram of optical power loss model, explanation and formulas used. 6.6 Introduction to FTTH and (GPON) Gigabit passive optical network **Course Outcome: CO5 Teaching Hours :10 Marks: 12 (R- 4, U- 6, A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Theory of optics and fundamentals of optical fiber**	4	4	-	08
2	**Optical fiber structure and components**	2	4	2	08
3	**Signal Degradation in Optical Fibers**	4	6	-	10
4	**Optical Sources and Detectors**	4	6	2	12
5	**Power Launching and Coupling**	2	6	2	10
6	**Multiplexing in Fiber Optic communication**	4	6	2	12
	Total	**20**	**32**	**08**	**60**

List of experiments: Total 10 experiments (or turns) out of 15 experiments (or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Setting Up of Fiber optic Analog link.	2
2	2	CO1	Setting Up of Fiber optic Digital link.	2
3	3	CO3	Measurement of NA of optical fiber.	2
4	4	CO4	Plot the characteristics of Fiber optic LED.	2

5	5	CO2	Joining of optical Fibers using different splicing techniques.	2
6	6	CO5	Perform Wavelength Division Multiplexing and Demultiplexing in optical fiber.	2
7	5	CO2	Measure the length of fiber spool using OTDR.	2
8	5	CO2	Calculate the splice loss and measure the length of fiber by using two fiber spool and OTDR.	2
9	5	CO2	Observe loss in LC/PC adapter and measure the length of fiber using spool and OTDR.	2
10	5	CO2	Observe attenuation and measure the length of fiber using spool and OTDR.	2
11	5	CO2	Plot the characteristics of Fiber optic Photo detector.	2
12	3	C03	Measurement of Bending Losses.	2
13	5	CO2	Mini project on simple optical transmitter and receiver or mechanical splicing optical connectors. (preparation and execution of actual mini project)	2
14	5	CO2	Mini project on simple optical transmitter and receiver or mechanical splicing optical connectors. (report writing)	2
15	1,2,3, 4,5,6	CO1, CO2, CO3, CO4, CO5	Case study on FTTH in any one locality in Mumbai	2
		Total		**30**

Note: Experiments No. 1 to 5 and 13 to 15 are compulsory and should map all units and CO. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Optical Fiber Communication	Gerd Keiser, Tata McGraw Hill	978125906876
2	Optical Network	Kumar Shiv Rajan, Morgan Kaufmann	978-0-12-374092-2
3	Optical Fiber Communication	John M Senior, Prentice Hall	81-203-0882-4
4	Gigabit passive optical network (GPON)	Srinath Srivatsa	978-1-4302-4873-6

E-References:

1. **http://www.bbcmag.com/2008issues/june08/BBP_June08_OtoL.pdf**
2. **http://www1.futureelectronics.com/doc/EVERLIGHT%C2%A0/334-15_T1C1-4WYA.pdf**
3. **For virtual lab : http://vlab.co.in**

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	2	1		
CO2	2	1	3	3	1	3	2	3	3	2
CO3	2	3	3	3	1	1	2	3	3	2
CO4	3	2	1	2	1	1	2	3	3	
CO5	2	1	3	3	1	1	2	3	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr Kiran Raghawan	Project Manager	Tejas Industry, Mumbai
2	Dr G.G.Sarate	HOD, Electronics	G.P. Amravati
3	Mrs S.V.Bannore (Curriculum Content Designer)	Sr.Lecturer	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____

Head of Department
Department of _____

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Electronics Engineering (Sandwich Pattern)**										
Course Code: **EC19406**				Course Title: **Mobile Communication**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30Min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**2**	**-**	**6**	**60**	**20**	**20**	**50***	-	**25**	**175**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill tesst are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

The 21st century has brought the rapid growth of cell phones, LAN and wireless appliances. Wireless communication is driving the whole world towards greater integrity. RF spectrum in higher bands is available for mobile communications. Mobility awareness in civilized societies, global standardization of wireless devices and products are leading towards huge growth. Students will know the fundamentals of mobile communication, basics of cellular system and different services provided by the cellular system. This subject gives the knowledge of cellular system architecture, components and its application along with its standards .It is the application of wireless digital communication.

Course Outcomes: Student should be able to

CO1	Describe different mobile communication system and their Antennas.
CO2	Understand Hand off strategies, Interference, coverage and capacity in cellular system.
CO3	Illustrate call flow sequences in GSM.
CO4	Comprehend the concept of CDMA (IS-95) standards, SS7 services and IMT 2000.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to wireless communication system:** 1.1 Working Principle of Wireless Communication. 1.2 Evolution of mobile radio communications (2G, 2.5G, 3G and 4G) 1.3 Introduction of Mobile radio system around the world. (Such as AMPS, N- AMPS, IS-95, GSM). 1.4 Applications of wireless communication systems such as paging system, cordless telephone system, cellular telephone system. 1.5 Call processing in cellular telephone system. **Course Outcome: CO1 Teaching Hours:10 Marks:10 (R- 4, U-4, A-2)**

2	**Mobile unit:** 2.1 Block Diagram and operation of mobile unit. 2.2 Block Diagram and Explanation of frequency synthesizer, transmitter, receiver, logic unit, control unit. 2.3 Essential features of handset. 2.4 Definition of mobile base station, Mobile control station. **Course Outcome: CO1 Teaching Hours:06 Marks:08 (R-4, U- 4, A--)**
3	**The cellular concept:** 3.1 Introduction of cellular system. 3.1.1 Frequency reuse concept. 3.1.2 Introduction of SDMA 3.1.3 Hand off strategies and their Types. 3.2 Interference and system capacity. 3.2.1 Co channel interference and system capacity 3.2.2 Channel planning for wireless system. 3.2.3 Adjacent channel Interference 3.3 Improving coverage and capacity in cellular system. 3.3.1 Cell splitting 3.3.2 Sectoring 3.3.3 Repeater for range extension 3.3.4 Micro cell zone concept **Course Outcome: CO2 Teaching Hours:14 Marks:14 (R-6, U-6, A-2)**
4	**Cell-Site Antennas and Mobile Antenna**: 4.1 Equivalent circuit of Antenna. 4.2 The Gain-and-Pattern relationship. 4.3 Sum-and-Difference Pattern. 4.4 Antenna at Cell site. 4.5 Unique Situations of Cell-Site. 4.6 Mobile Antennas. **Course Outcome: CO1 Teaching Hours:10 Marks:08 (R-4, U-4, A--)**
5	**Digital cellular mobile systems:** 5.1 G.S.M: 5.1.1 GSM Standardization and service aspects 5.1.2 GSM Architecture 5.1.3 G.S.M Radio Aspects 5.1.4 Security Aspects 5.1.5 Typical call flow sequences in GSM 5.2 Signal system no.7 (SS7): services and performance. 5.3 IS-95: Concept of IS 95, the North American CDMA Digital Cellular standard. [08] 5.3.1 Introduction 5.3.2 Service Aspects 5.3.3 Network reference Model and Security aspects 5.3.4 Radio aspects

	5.3.5 Key features of IS 95 CDMA systems **Course Outcome: CO3 and CO4 Teaching Hours:12 Marks:14 (R-8 , U-6, A--)**
6	**Modern wireless communication system and Networks:** 6.1 State features of 3G wireless networks- UMTS, CDMA 2000. 6.2 WLL(Wireless local loop) and LMDS (local multipoint distribution) technology 6.3 IMT 2000: 6.3.1 IMT 2000 Vision and Evolution Aspects. 6.3.2 Radio Spectrum for IMT -2000. **Course Outcome: CO4 Teaching Hours:08 Marks:06 (R-2, U-2, A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to wireless communication system**	4	4	2	10
2	**Mobile unit**	4	4	-	08
3	**The cellular concept**	6	6	2	14
4	**Cell-Site Antennas and Mobile Antenna**	4	4	-	08
5	**Digital cellular mobile systems**	8	6	-	14
6	**Modern wireless communication system and Networks**	2	2	2	06
	Total	**28**	**26**	**06**	**60**

List of experiments: Total 10 experiments out of 15 experiments

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Perform installation of mobile phone.	02
2	1	CO2	Observe Input / Output signal of different sections Mobile unit.	02
3	2	CO3	Read the content of SIM card.	02
4	2	CO4	To understand and perform charging of handset.	02
5	2	CO2	Testing of mobile handset.	02
6	2	CO2	Find out different add- on accessories for cell phones (battery, charger, hands free data cable)	02
7	2	CO3	Identify different sections and component of mobile unit (Ringer section, dialer section, receiver section, transmitter section etc.)	02
8	2	CO3	To Trace different sections of Mobile Unit.	02

9	3	CO3	Demonstration of handoff, frequency response, cell splitting.	02
10	3	CO3	Prepare report on different facilities provided by cellular company (visit)	02
11	3	CO3	Prepare report on cellophane operator companies and their plan and traffic. (Visit)	02
12	5	CO3	Prepare report on GSM technology, its network, GSM capability & data Services.	02
13			Case study: features, services provided by different companies	02
14			Mini Project: Electronic notice board using GSM, Vehicle tracking system, Home security system etc. Note: Only software or program required (No need of Hardware)	04
Total				**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and COs. Remaining experiments are to be performed depending on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Wireless Communication Principles & Practice	T.S. Rappaport, Pearson Education	978-0130422323
2	Mobile communication System	William Lee, Tata McGraw Hill	9780070370395
3	Mobile Computing	Asoke Talukder, Roopa Yavagal, Tata McGraw Hill	9780070588073
4	Mobile Communication	Jochen Schiller, Pearson Education Asia	9780201398366
5	Mobile and Personal Communication Systems and Services	Raj Pandya, IEEE Press, PHI	0471660965, 9780471660965
6	Mobile wireless Networks	C K Toh Ad Voc, Pearson Education	9780130078179

E-References:

1. https://ndl.iitkgp.ac.in/
2. https://www.electronicshub.org/
3. https://www.tnuda.org.il/
4. www.youtube.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	2	-	1	1	2	1	2	-
CO2	2	2	2	-	1	1	2	1	2	2
CO3	3	1	1	1	1	-	2	1	2	2
CO4	2	1	1	-	1	1	2	-	2	-

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mrs. Salunke Suvarna	Sr. Controls Engineer	Vanderlande Industries Software Pvt Ltd.Pune
2	Mrs. Chavhan Monali	Lecturer in Electronics	Government Polytechnic, Vikramgadh
3	Mrs. Puri Sanyogeeta B.	Lecturer in Electronics	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____

Head of Department
Department of _____

I/C, Curriculum Development Cell

Principal