Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Electronics and Telecommunication Engineering   **Semester -VI**

A)	Course Code	: **2028671(028)**
B)	Course Title	: **Cellular and Optical communication**
C)	Pre-requisite Course Code and Title	: **Communication System-I and II**
D)	Rationale	:

In the age of information technology, it is necessary to connect to the data network from anywhere, with anybody, at any time. Mobile communication provides connectivity with mobility, flexibility and convenience. Mobile devices are used across the various industries like Healthcare, Education, Automation, Renewable energy sector, Automobile etc., also optical communication technology is developing at very fast pace due to huge available bandwidth, cost trends for fiber vs. copper, better transmission quality, high noise immunity, high data rate, and reduction in fiber maintenance expenses. This course will facilitate students to develop skills to maintain mobile communication systems and optical communication system used in different types of networks and applications.

E)   Course Outcomes:

CO-1   Troubleshoot mobile handset.

CO-2   Interpret functions of various components of cellular mobile communication system.

CO-3   Analyse GSM and CDMA mobile communication standards/system.

CO-4   Interpret the functions of the various blocks of optical fiber communication system.

CO-5   Select appropriate optical network component for the given function.

F)   Scheme of Studies:

S.No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit L+T+P/2
1	E&TC Engineering	2028671(028)	Cellular and Optical Communication	2	-	1	3
2	E&TC Engineering	2028661(028)	Cellular and Optical Communication (Lab)	-	2	-	1

Legend: L - Lecture   T - Tutorial   P – Practical

G)   Scheme of Assessment:

S. No	Board of Study	Course Code	Course Title	Schemes of Examination					Total Marks
				Theory			Practical		
				ESE	CT	TA	ESE	TA	
1	E&TC Engineering	2028671 (028)	Cellular and Optical Communication	70	30	30	-	-	130
2	E&TC Engineering	2028661 (028)	Cellular and Optical Communication (Lab)	-	-	-	30	50	80

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H)   Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1   Troubleshoot mobile handset.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define the given terms used in mobile communication system. SO1.2 Compare the characteristics of the given generations of mobile communication. SO1.3 Explain with relevant sketch the working principle of the given section of mobile handset unit. SO1.4 Describe step by step trouble shooting procedure for the given section of mobile phone.	LE1.1 Identify different sections and sensorsof the given mobile phone. LE1.2 Identify the inbuilt sensors of the given smart mobile hand set and test their performance. LE1.3 Interpret input/ output signals of different sections of mobile phone unit. LE1.4 Test the supply of the Transmitter /Receiver section of mobile handset. LE1.5 Test the Battery charger section and power management unit of Mobile phone unit. LE1.6 Test the workingLCD and SIM section of Mobile phone unit. LE1.7 Test the User Interface section (Keyboard Buzzer, Vibrator, LED, Mic, and Speaker) of Mobile phone unit. LE1.8 Perform registration, activation, authentication and installation of mobile applications on mobile handset. LE1.9 Troubleshoot the Battery charger section, LCD section and SIM card section of the mobile handset. LE1.10Troubleshoot the speaker problem, Ringer problem, Microphone problem, vibrator problem (User Interface section). LE1.11Read the contents of SIM card using relevant software.	**Unit 1.0Introduction to Mobile Communication** 1.1 Evolution of Mobile Radio Communication, Definition of basic terms used in mobile communication: forward channel, handoff, Mobile Station (MS), Mobile Switching Centre(MSC), reverse channel,subscriber and transceiver, mobile communication frequency bands and channel bandwidth 1.2 Generations of mobile communication:First Generation (1G), Second Generation (2G), 2.5 G, Third Generation (3G), Fourth Generation (4G), and Fifth Generation (5G) networks 1.3 Mobile Phone Unit(Mobile handset) : Block diagram , working, features of transmitter and receiver section, power supply section, sensors: speakers and microphone, camera, touch screen, battery and battery charger section, SIM slots, memory slots, motion sensors and other common sensors used in the smart phone, SIM card and its functions, registration, activation, authentication and installation of mobile applications on mobile handset, basic mobile trouble shooting procedure and commands	• Comparison of LTE and VoLTE standards. • Describe types of SIM and SIM functions

SW-1   **Suggested Sessional Work (SW):**

     a.   **Assignments:**
         i.   List and compare the characteristics of various generations of mobile communication.
         ii.   Describe the functions of various sensors od a smart phone.

     b.   **Mini Project:**
         i.   Visit nearby mobile service provider switching exchange/MTNL or BSNLexchange and prepare detail report of entire setup of their cellular system.
         ii.   Prepare a chart to represent the sections of smart Mobile hand set and its functions.

     c.   **Other Activities (Specify):**
         i.   Compare various mobile radio standards presently used in our country.
         ii.   Prepare a survey report on mobile services provided by the various mobile service providers.

CO-2   **Interpret functions of various components of cellular mobile communication system.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Explain the given terms, with respect to Cellular systems. SO2.2 Apply the principle of frequency reuse for increment in the given coverage area. SO2.3 Suggest the handoff mechanism for the given situation with justification. SO2.4 Explain the effect of the given interference on cellular system performance SO2.5 Select the relevant method to improve coverage and system capacity of the given cellular system with justification.	LE2.1 Execute call control commands using relevant software. LE2.2 Execute Network Service Commands using relevant software. LE2.3 Execute Security commands using relevant software. LE2.4 Execute Phone Book commands using relevant software. LE2.5 Execute short message commands using relevant software. LE2.6 Execute Data commands using relevant software. LE2.7 Execute Specific AT commands using relevant software commands using relevant software.	**Unit 2.0 CellularConcepts** 2.1 Cell structure and its types, Cluster, Reuse factor, minimum reuse distance, basic cellular system : mobile station, base station, Traffic channel (Forward and Reverse) , Control channel (Forward and Reverse), Frequency reuse, channel assignment strategies 2.2 Handoff strategies: Concept of handoff, Types of Handoffs: Hard, Soft, Queued, delayed, MAHO (Mobile Assisted Handoff) , Proper and Improper Handoff, Umbrella cell approach 2.3 Interference: Co-Channel interference and reduction, Adjacent Channel Interference and reduction 2.4 Improving Coverage and capacity in cellular systems: Cell splitting, Sectoring, frequency reuse,hand off 2.5 Mobile testing commands:Call control commands, network service commands, security commands, phone book commands, short message commands, data commands, AT commands	• Compare various handoff strategies • Describe the frequency reuse concept for capacity improvement

SW-2   **Suggested Sessional Work (SW):**

a. **Assignments:**
   i. Explain how cellular concept enhances system capacity?
   ii. Define frequency reuse. Why frequency reuse is essential?

b. **Mini Project:**
   i. Demonstrate the general steps to repair Mobile handset.
   ii. Compare the technical specification of various smart phone.

c. **Other Activities (Specify):**
   i. Visit nearby mobile switching center and prepare a report on it.
   ii. Conduct a survey to compare the mobile services provided by the various service providers.

CO-3   **Analyse GSM and CDMA mobile communication standards/system.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Describe with relevant sketch the architecture of the given cellular. standard. SO3.2 Describe features, of the given mobile communication standard. SO3.3 Describe the functions of the various GSM channels. SO3.4 Describe the function of the given block of the CDMA system. SO3.5 Describe with relevant sketch call processing stages in the given cellular standard.	LE3.1 Test /Analyze real time GSM Command concerning modem & SIM card hardware. LE3.2 Test /Analyze real time GSM Network registration commands. LE3.3 Test /Analyze real time GSM Call control command. LE3.4 Test /Analyze real time GSM Call setting commands. LE3.5 Test /Analyze real time GSMCall information commands. LE3.6 Test /Analyze real time GSMPhone Book commands. LE3.7 Test /Analyze real time GSMSerial link control commands. LE3.8 Test /Analyze real time GSMMessage setting commands. LE3.9 Test /analyzereal time GSMStoring/restoring. commands.	**Unit 3.0 Cellular Network Standards** 3.1 Global System for Mobile(GSM): System architecture and interfaces, services and features, Handover, GSM channels, establishment of a GSM call, Channel uses during GSM call, User Validation 3.2 CDMA Technology for Mobile: System architecture, system blocks and functions, CDMA channels, establishment of a CDMA call, User Validation	• CompareGSM and CDMA technology. • Describe the user validation for GSM and CDMA

SW-3   **Suggested Sectional Work (SW):**

a. **Assignments:**
   i. Explain the system architecture of GSM and CDMA technology.
   ii. Differentiate between GSM and CDMA channels.

b. **Mini Project:**

i. Prepare a detail list of equipment and software required to troubleshoot the mobile handset.
ii. Prepare a chart indication block diagram of GSM and CDMA switching center.

   c. Other Activities (Specify):
      i. Seminar on GSM and CDMA mobile technologies.
      ii. Discussion on Mobile services.

CO-4   **Interpret the functions of the various blocks of optical fiber communication system.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Compare the characteristics of optical fiber communication with other wired communication. SO4.2 Select proper optical frequency band for the given application. SO4.3 Describe the functions of the given blocks of the Optical fiber communication system SO4.4 Describe the various parts of fiber cable with neat sketch. SO4.5 Compare the properties of step and graded indexed fiber. SO4.6 Explain the cause of losses occurred in the optical fiber.	LE4.1 Calculate Numerical Aperture (NA) and acceptance angle for the given optical fiber cable. LE4.2 Measure attenuation losses for the given length of optical fiber cable. LE4.3 Measure bending losses of the given optical fiber optic cable. LE4.4 Measure attenuation losses for the given length of optical fiber cable.	**Unit 4.0 Overview of Optical Fibre Communication** 4.1 Evolution of Fibre Optic communication, frequency bands of optical fiber communication and their applications 4.2 Elements of an Optical Fibre Transmission link 4.3 Ray theory of propagation of light, refractive index, numerical aperture, fibre cable structure: core and cladding, modes of light transmission through step index fiber and graded index fiber 4.4 Fiber materials-Glass fibers, and plastic fibers 4.5 Types of losses and attenuation in optical fibers: attenuation due to absorption and scattering.	• Describe the properties of materials used for manufacturing of optical fibre cables. • List advantage and disadvantages of Optical fiber communications.

  SW-4   **Suggested Sectional Work (SW):**

   a. Assignments:
      i. Define acceptance angle, critical angle and numerical aperture of the given optical fiber cable.
      ii. Compare properties of plastic and glass fiber.

   b. Mini Project:
      i. List the specification of various optical devices used in the industries.
      ii. Undertake Internet based survey for various optical fiber cables available in market. (different types of optical cables, give its specification and application)

   c. Other Activities (Specify):
      i. Prepare a chart to represent step by step procedure to connect optical fiber cable with given instrument.
      ii. Show the video on optical fiber fabrication.

CO-5   Select appropriate optical network component for the given function.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Describe with sketch working principle of the given type of optical source. SO5.2 Describe with sketch construction of the given type ofoptical detector. SO5.3 Interpret labeled characteristics of the given photo detector. SO5.4 Describe with sketch the working principle of the given photo detector. SO5.5 Describe basic diagram of optical fiber coupler types and functions. SO5.6 Explain the step by step procedure of the given Splicing techniques. SO5.7 Describe the given types of optical fiber losses. SO5.8 Explain operation of the given block of OTDR.	LE5.1 Test the performance of the given LASER as an optical source. LE5.2 Measure wavelength of light emitted by the LED using Lux meter for different input current. (Plot the graph of current Vs intensity). LE5.3 Test the performance of the given photo-diode (Detector) use LED as an optical source. LE5.4 Test performance of given photo-diode (Detector), use LASER as optical source. LE5.5 To establish fibre optic analog link. LE5.6 Establish PC to PC communication linkusing optical fiber cable as transmission media.(Digital optical fiber system). LE5.7 Calculate bandwidth of optical fiber Analog Link.	**Unit 5.0 Fibre Optic CommunicationComponents** 5.1 Optical sources: LED and LASER diode, construction , working principle and characteristics 5.2 Optical detectors: PIN diode, photodiodes, Avalanche photodiodes, construction , working principle and characteristics 5.3 Fibre joints,splices ,connectors, coupler, circulator and isolator 5.4 Optical Fibre link design: Power budget analysis 5.5 Basics of optical powermeter and OTDR(Optical Time Domain Reflectometer).	• Compare the characteristics of LED and LASER. • Describe the functions of OTDR. • Explain features of optical coupler and isolator.

Legend:CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5   Suggested Sectional Work (SW):

a. **Assignments:**
    i.   Describe the techniques to minimize optical fiber losses.
    ii. Prepare a survey report to compare technical specification of different types of optical sources and detectors.
    iii. Undertake a survey to collect the information on different types of optical cables, give its specification and application.

b. **Mini Project:**
    i.   Describe the procedure to maintain the given type of optical fiber network.
    ii. Describe various splicing techniques used in industries.

c. **Other Activities (Specify):**
    i.   Prepare a report by monitor an optical networking used by cable service provider (TV and internet).
    ii. Watch the video on how to use OTDR and splicing tool and summarize the procedure.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) **Suggested Specification Table (For ESA of Classroom Instruction):**

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	Introduction to Mobile Communication	5	5	4	14
II	Cellular Concepts	4	5	5	14
III	Cellular Network Standards	5	5	4	14
IV	Overview of Optical Fibre Communication	5	5	4	14
V	Fibre Optic Communication Components	4	4	6	14
	Total	**23**	**24**	**23**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J) **Suggested Specification Table (For ESA of Laboratory Instruction*):**

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Identify different sections and sensors of the given mobile phone.	15	10	5
LE1.2	Identify the inbuilt sensors of the given smart mobile hand set and test their performance.	15	10	5
LE1.3	Interpret input/ output signals of different sections of mobile phone unit.	15	10	5
LE1.4	Test the supply of the Transmitter /Receiver section of mobile handset.	15	10	5
LE1.5	Test the Battery charger section and power management unit of Mobile phone unit.	15	10	5
LE1.6	Test the LCD and SIM section of Mobile phone unit	15	10	5
LE1.7	Test the LCD and SIM section of Mobile phone unit.	15	10	5
LE1.8	Test the User Interface section (Keyboard Buzzer, Vibrator, LED, Mic, and Speaker) of Mobile phone unit.	15	10	5
LE1.9	Troubleshoot the Battery charger section, LCD section and SIM card section of the mobile handset.	15	10	5
LE1.10	Troubleshoot the speaker problem, Ringer problem, Microphone problem, vibrator problem (User Interface section).	15	10	5
LE1.11	Read the contents of SIM card using relevant software.	15	10	5
LE2.1	Execute call control commands using relevant software.	15	10	5
LE2.2	Execute Network Service Commands using relevant software.	15	10	5
LE2.3	Execute Security Commands using relevant software.	15	10	5
LE2.4	Execute Phone Book commands using relevant software.	15	10	5
LE2.5	Execute short message commands using relevant software.	15	10	5
LE2.6	Execute Data commands using relevant software.	15	10	5
LE2.7	Execute Specific AT commands using relevant softwarecommands using relevant software.	15	10	5

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE3.1	Test /Analyze real time GSM Command concerning modem & SIM card hardware.	15	10	5
LE3.2	Test /Analyze real time GSM Network registration commands.	15	10	5
LE3.3	Test /Analyze real time GSM Call control command.	15	10	5
LE3.4	Test /Analyze real time GSM Call setting commands.	15	10	5
LE3.5	Test /Analyze real time GSM Call information commands.	15	10	5
LE3.6	Test /Analyze real time GSM Phone Book commands.	15	10	5
LE3.7	Test /Analyze real time GSM Serial link control commands.	15	10	5
LE3.8	Test /Analyze real time GSM Message setting commands.	15	10	5
LE3.9	Test /analyze real time GSM Storing/restoring. commands.	15	10	5
LE4.1	Calculate Numerical Aperture (NA) and acceptance angle for the given optical fiber cable.	15	10	5
LE4.2	Measure attenuation losses for the given length of optical fiber cable.	15	10	5
LE4.3	Measure bending losses of the given optical fiber optic cable.	15	10	5
LE4.4	Measure attenuation losses for the given length of optical fiber cable .	15	10	5
LE5.1	Test the performance of the given LASER as an optical source.	15	10	5
LE5.2	Measure wavelength of light emitted by the LED using Lux meter for different input current. (Plot the graph of current Vs intensity).	15	10	5
LE5.3	Test the performance of the given photo-diode (Detector) use LED as an optical source.	15	10	5
LE5.4	Test performance of given photo-diode (Detector) use LASER as optical source.	15	10	5
LE5.5	To establish fibre optic analog link.	15	10	5
LE5.6	Establish PC to PC communication linkusing optical fiber cable as transmission media(Digital optical fiber system).	15	10	5
LE5.7	Calculate bandwidth of optical fiber Analog Link.	15	10	5

* Assessment rubric, process and product check list   with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend :   PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of 30 Marks as perassessment scheme

K)   **Suggested Instructional/Implementation Strategies:**

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training

7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L)   Suggested Learning Resources:

(a)   Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Wireless Communications: principles and practice	T.S. Rappaport	Pearson Education, New Delhi	2nd edition, 2013 or latest edition
2	Mobile Computing	SipraDasBit, Biplab K. Sikdar	PHI ,New Delhi	2nd edition, 2015 or latest edition
3	Mobile Cellular Telecommunication	William C.Y. Lee	TATA McGRAW HILL, New Delhi	2nd edition, 2012 or latest edition
4	Mobile Communication	Jochen Schiller	Pearson Education, New Delhi	2nd edition, 2005 or latest edition
5	Mobile Cellular Telecommunications System	Lee, C. Y. William	Tata Mcgraw Hill Education, New Delhi, 2017 ISBN-13: 978-0070635999	3rd edition or latest edition
6	Wireless Communication	Singal, T. L.	Tata McGraw Hill Education Private Limited, New Delhi, 2010, ISBN: 978-0-07-068178-1	2010 or latest edition
7	Wireless and mobile network Architectures	Lin Yi-Bang ClamtacImrich	John Wiley& sons, New Delhi,2001 ISBN : 978-81-265-1560-8	2008 or latest edition
8	Fundamentals of Optical Fibre Communication	M. Satish Kumar	PHI, New DelhiISBN-978-81-203-2781-8	2010, 4th edition
9	Optical Fibre Communication	Gerd Keiser	McGraw Hill, New Delhi ISBN-0-07-116468-5	2000, 3rd edition
10	Optical Fiber Communications Principles and practice	Senior John M.	Pearson Education Limited New Delhi, ISBN: 9788131732663, 8131732665	3rd edition, 2010

(b)   Open source software and website address:

1. Mobile phone repairing tools and equipments : - www.mobilecellphonerepairing.com › Mobile Phone Repairing Tools

2. VoLTE:- /www.gsma.com/futurenetworks/wp-content/uploads/2014/.../FCM.01-v1.1.pdf
3. The Evolution of mobile technologies: -https://www.qualcomm.com/.../the-evolution-of-mobile-technologies-1g-to-2g-to-3g-
4. 5G Wireless Technology:-https://www.qualcomm.com/invention/5g/technologies
5. PIN Photodiode and AvalanchePhotodiode**:**https://electronicscoach.com/types-of-photodiode.html
6. Optical wavelength bands: http://www.bbcmag.com/2008issues/june08/BBP_June08_OtoL.pdf
7. LED data sheet:- http://www1.futureelectronics.com/doc/EVERLIGHT%C2%A0/334-15__T1C1-4WYA.pdf

M)   **List of Major Laboratory Equipment and Tools:**

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Mobile Phone Trainer kit	Cellular System : EGSM/GSM 900/ 1800 MHz (3GDualband) Rx frequency band (Downlink): EGSM 900 : 925-960 MHz GSM 900 : 935- 960 MHz GSM 1800 : 1805-1880MHz Tx frequency band (Uplink) : EGSM 900 : 880- 890MHz GSM 900 : 890- 915 MHz GSM 1800 : 1710-1785MHz Output power : +5 ,+33 dBm / 3.2 mW , Channel spacing : 200 KHz Display : TFT, 256 K colours,128X 160 Pixels, 2.0", SIM support : Smart Dual SIM, Dual stand by (both GSM) Battery type : Li-Ion 1000m AH C PU : 208 MHz Sound : Speaker and Earphone Jack (3.5 mm) On board sections : Keypad, Dual SIM, Charging Circuit, Clock, User interface such as Buzzer, Vibrator, LEDs. Test points: 50 nos. (Gold plated) Features that can be set :Screen savers, Ring tones, Logos, SMS	LE1.1 – LE 1.11,LE2.1 -LE2.7. LE3.1-LE3.9
2	Spectrum Analyzer	9KHz to 1.5 GHz frequency range, Typical 135dBm Displayed average noise level(DANL) 80dBc/Hz @ 10KHz offset, phase noise Total amplitude Uncertainty <`1.5dB, 100Hz Minimum Resolution Bandwidth (RBW), Frequency Resolution 1Hz, Frequency span range 0 Hz, 100 Hz to maximum Frequency of instrument, Video bandwidth (-3db) 1Hz to 3 MHz in 1-3-10 sequence	LE1.4,LE5.1,LE5.7
3	Digital Multimeter (3 1/2Digital Multimeter)	4000 counts large LCD display with auto/manual range, No Power OFF under natural operation ,Data Hold, Max/Min value Hold Capacitance, Frequecy/Duty Cycle	LE1.2,LE1.4,LE1.5,LE1.6,LE1.7, LE1.8,LE1.10, LE1.11,LE4.2,LE5.3, LE5.4
4	Digital Storage Oscilloscope	100 MHz with 64K color TFT, 16kbps memory, FFT function, alternate triggering, Roll Mode, Math Function, digital filter, waveform recorder,20 automatic measurements, Standard USB host, USB device with waveform analysis software	LE1.4,LE5.1,LE5.2,LE5.3,LE5.4, LE5.7

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
5	SIM Card Reader	Trainer for Simcard reader	LE1.3,LE1.7
6	Fast Battery charger	Tool to study fast battery charger	LE1.6
7	Mobile handset Tools	toolkit for Mobile handset repairing	LE1.10,1.11
8	Power Supply	Power Supply Type: DC, 0- 30 V, 0 - 3A	ALL EXPERIMENTS
9	Lux meter	Display: 3 1/2 digit 18mm (0.7") /LCD •Ranges: 1 to 50,000 LUX /Over-input: indication of " 1 " /Sampling Time: 0.5 second /Repeatability: ±2% /Temperature Characteristic: ±0.1%/? •Accuracy: ±4%rdg ±0.5%f.s	LE5.2
10	OTDR	Attenuation resolution-0.001 dB, Attenuation measurement linearity 0.05 dB, Distance measurement accuracy ± (0.5 + resolution + 5 × 10-5 × L) m	LE4.2-LE4.4
11	PC	Processor - dual core @ 2.4 GHz (i5 or i7 Intel processor or equivalent AMD),RAM - 4 GB, Hard Drive - 320 GB 5400 RPM hard drive,OS- win7/10	LE5.6
12	Fiber optic Trainer	Trainer kit for optical fibre communication, can setup analog and digital link, loss and NA measurement, List of practical preformed with complete Lab manual	LE4.1-LE4.4.LE5.1-LE5.7

N)   Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Troubleshoot mobile handsets.	2	3	3	3	3	2	2	2	2	3	3	3
CO-2 Interpret functions of various components ofcellular mobile communication system.	2	3	3	3	3	2	1	2	2	3	3	3
CO-3 Analyse GSM and CDMA mobile communication standards/system.	1	3	3	3	3	2	1	2	2	3	3	3
CO-4 Interpret the functions of the various blocks of optical fiber communication system.	2	2	3	3	3	3	2	2	2	3	3	3
CO-5 Select appropriate optical network component for the given function.	1	2	3	3	3	3	-	2	2	2	3	2

Legend: 1 – Low, 2 – Medium, 3 – High

O)   Course Curriculum Map:

POs & PSOs No.	COs No.& Titles		SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1	Troubleshoot mobile handsets.	SO1.1,SO1.2 SO1.3, SO1.4	LE1.1,LE1.2,LE1.3, LE1.4,LE1.5, LE1.6,LE1.7,LE1.8, LE1.9,LE1.10,LE1.11	Unit1.0Introduction to Mobile Communication 1.1,1.2,1.3	As mentioned in relevant page number
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2	Interpret functions of various components ofcellular mobile communication system.	SO.2.1,SO.2.2, SO2.3, SO.2.4, SO.2.5	LE2.1,LE2.2,LE2.3, LE2.4, LE2.5, LE2.6, LE2.7	Unit 2.0 Cellular Concepts 2.1,2.2,2.3,2.4,2.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3	Analyse GSM and CDMA mobile communication standards/system.	SO.3.1, SO3.2 SO3.3, SO3.4, SO3.5	LE3.1,LE3.2, LE3.3, LE3.4, LE3.5, LE3.6, LE3.7, LE3.8, LE3.9,	Unit 3.0Cellular Network Standards 3.1,3.2	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4	Interpret the functions of the various blocks of optical fiber communication system.	SO4.1, SO4.2, SO4.3, SO4.4, SO4.5, SO4.6	LE4.1,LE4.2,LE4.3, LE4.4	Unit 4.0 Overview of Optical Fibre Communication 4.1,4.2,4.3,4.4,4.5	
PO-1,2,3,4,5,6, 8,9,10 PSO-1,2	CO-5	Select appropriate optical network component for the given function.	SO5.1,SO5.2, SO5.3, SO5.4, SO5.5, SO5.6, SO5.7, SO5.8	LE5.1, LE5.2,LE5.3, LE5.4, LE5.5,LE5.6, LE5.7	Unit 5.0 Fibre Optic Communication Components 5.1, 5.2, 5.3, 5.4, 5.5	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

Diploma in Electronics and Telecommunication Engineering   Semester -VI

A)	Course Code	:	2028672(028)
B)	Course Title	:	Computer Network
C)	Pre-requisite Course Code and Title	:	Communication-I, Communication-II
D)	Rationale	:	

Computer networks are the backbone of World Wide Web (www) internet services. The aim of the course is to provide the basic knowledge of computer networking, and to develop the skills to establish, operate, test, configure and to troubleshoot the hardware and software involved in the computer networks. The emphasis is given on practical oriented techniques.

E)   Course Outcomes:

CO-1   Apply the concepts of Computer networking to interpret the working of various sections of computer networks.

CO-2   Interpret the functions of the various Network reference model's layers used to develop/ maintain computer network.

CO-3   Select the appropriate type of line coding and switching techniques for the specific type of computer networks.

CO-4   Interpret the different network Protocols to develop / maintain computer network.

CO-5   Install various Networking devices used in the various computer networks.

F)   Scheme of Studies:

S.No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit L+T+P/2
1	E&TC Engineering	2028672(028)	Computer Network	2	-	1	3
2	E&TC Engineering	2028662(028)	Computer Network (Lab)	-	4	-	2

Legend: L - Lecture   T - Tutorial   P - Practical

G)   Scheme of Assessment:

S.No	Board of Study	Course code	Course Title	Schemes of Examination					
				Theory			Practical		Total
				ESE	CT	TA	ESE	TA	Marks
1	E&TC Engineering	2028672 (028)	Computer Network	70	30	30	-	-	130
2	E&TC Engineering	2028662 (028)	Computer Network (Lab)	-	-	-	30	50	80

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H)   Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1　Apply the concepts of Computer networking to interpret the working of various sections of computer networks.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 List the applications of the given type of Computer Networks. SO1.2 Compare the given type of modes of communication. SO1.3 Differentiate between the given types of line configurations. SO1.4 Summarize the characteristics of the given network topology.	LE1.1 Establish a network to connect computers/nodes in the given topology.	**Unit 1.0 Basics of Computer Networking** 1.1　Definitions and history of computer networks 1.2　Types of network 　　a.　LAN, MAN, WAN 　　b.　Wired and Wireless 1.3　Applications of various types of Computer Networks 1.4　Standard Organizations and Protocols 1.5　Computer network services: Connection less and Connection oriented 1.6　Mode of Communication 　　1.6.1 Simplex 　　1.6.2 Half duplex 　　1.6.3 Full Duplex 1.7　Line Configuration 　　1.7.1　Point to Point connection 　　1.7.2　Point to multi point connection 　1.8 Network Topology 　　1.8.1 Bus Topology 　　1.8.2 Ring Topology 　　1.8.3 Star Topology 　　1.8.4 Mesh Topology 　　1.8.5 Hybrid Topology	• Differentiate between internet and intranet. • Compare point to point and multipoint connection. • Differentiate Connection oriented and Connection less transmission. • List the names of guided and unguided transmission media.

SW-1　Suggested Sessional Work (SW):

a. **Assignments:**
  i.　List advantages and disadvantages of different types of network topology.
  ii.　Identify the applications of various types of computer network topology.
  iii.　Describe merits and demerits of LAN, MAN, WAN.

b. **Mini Project:**
  i.　Develop a small network layout based on LAN for a hospital (maximum no of nodes are 100).

c. **Other Activities (Specify):**
  i.　Identify different type of computer networks used in real life situations.
  ii.　Present seminar on wired and wireless communication medium.

CO-2 Interpret the functions of the various Network reference model's layers used to develop/ maintain computer network.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Interpret functions of TCP/IP model. SO2.2 Explain the basic functions of each layer of OSI reference model. SO2.3 Compare TCP/IP and OSI model. SO2.4 List the name of link to link and end to end layer of the given type of network model.	LE2.1 Prepare a layout demonstrating data transfer aspects as per TCP/IPI model between computing devices.	**Unit 2.0 Reference Models for Network Implementation** **2.1** TCP/IP model and its layers, main functions of each layer, feature and protocol of each layer **2.2** OSI model, functions and features of each layer: Physical Layer, Data Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer **2.3** Compare OSI and TCP/IP model	• Explain peer to peer process involved of different layers • Define the following: port, logical and physical address, layer, layer interface

SW-2 **Suggested Sessional Work (SW):**

a. **Assignments:**
   i. List layer wise protocol of TCP/IP Model.
   ii. Explain any one protocol of each layer of OSI Model.
   iii. Explain Error detection and correction mechanism in Data link layer.
   iv. Describe the strategy to map the application layer of the TCP/IP model with the OSI model.

b. **Mini Project:**
   i. Prepare a chart to show all protocol format structure of OSI and TCP/IP reference model.

c. **Other Activities (Specify):**
   i. Prepare presentation on the functions of each layer of OSI model.

CO-3 Select the appropriate type of line coding and switching techniques for the specific type of computer networks.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 List the properties of line coding. SO3.2 Analyze the given type of line coding scheme. SO3.3 Identify appropriate switching scheme for the given type of transmission mode. SO3.4 Compare the given types of switching techniques.	LE3.1 Measure the signal parameters of Unipolar coded signal. LE3.2 Measure the signal parameters of Manchester coded and decoded signal. LE3.3 Install and test the working function of the given modem.	**Unit 3.0 Line Coding and Switching** 3.1 Properties of Line Coding 3.2 Line coding schemes Unipolar :NRZ, RZPolar: NRZ, RZ, Biphase Bipolar: AMI 3.3 SwitchingCircuit SwitchingMessage Switching Packet Switching 3.4 Multiplexing 3.5 Modem and modem types, specifications, null modem, modem functions and installation	• Identify the characteristics of different types of Line code • Explain the need forswitching in computer network

SW-3   Suggested Sectional Work (SW):

a. **Assignments:**
  i.   Given the binary sequence x = {1, 0, 1, 0, 1, 1},
       sketch the waveforms representing the sequence x using the following linecodes:
       a. Unipolar NRZ; b. polar NRZ; c. Unipolar RZ; d. bipolar RZ; e. Manchester. Assume unit pulse amplitude and use binary data rate Rb = 1 kbps.
  ii. List three techniques of Digital to Digital conversion.
  iii. Describe the need for linecoding.
b. **Mini Project:**
  i.   Prepare a chart to Compare the switching techniques used for computer networking.
c. **Other Activities (Specify):**
  i.   Prepare Chart on different line coding schemes.
  ii. Prepare a PPT on different switching schemes.

CO-4   Interpret the different network Protocols to develop / maintain computer network.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain application of IPv4 and IPv6 protocol. SO4.2 Select appropriate class of address for given network size. SO4.3 Create and configure Subnet for the given LAN. SO4.4 Describe the functions of DNS, FTP andHTTP.	LE4.1 Implementing an IP Addressing Scheme for the given type of network. LE4.2 Write a program for demonstrating: - 1. TELNET 2. FTP 3. PING LE4.3 Install and configure a network adapter of the given computer system and network.	**Unit 4.0 Network Protocol and Applications** 4.1 IP Protocol – IP v4, IP v6. 4.2 Addressing Schemes 4.3 Subnet and Supernet masking 4.4 DNS,FTP,HTTP 4.5 Email , SMTP, ICMP 4.6 TCP and UDP 4.7 ARP and RARP	• List the functions of URL , search engine and web browser • Differentiate between http and https

SW-4   Suggested Sectional Work (SW):

a. **Assignments:**
  i.   Classify different class of IP address with suitable example.
  ii. Determine IP address, subnet number, number of host, mask for the given subnet.
  iii. Explain the procedure to trouble shoot IP addressing conflict.
  iv. Describe ARP and RARP, ICMP, SMTP protocol.

b. **Mini Project:**
  i.   Set, Configure and Test internet for the given typaod network topology.

c. **Other Activities (Specify):**
  i.   Prepare a PPT on supernet and subnet masking scheme for network addressing.
  ii. Seminar on IPv4 and IPV6 addressing schemes.

CO-5   **Install various Networking devices used in the various computer networks.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Define the given network performance parameter. SO5.2 List the function and use of the given network device. SO5.3 Suggest the name of thenetwork device for the given layer and for the given applications.	LE5.1 Prepare cross-wired cable and straight through cable using clamping tool. LE5.2 Install, configure and test the given hub for networking. LE5.3 Install, configure and test the givenswitches for networking. LE5.4 Install, configure and test the givenRouters for networking LE5.5 Test the various basic network command and network configuration commands. LE5.6 Install the LAN of 10 computers. LE5.7 Prepare RJ-45 cable.	**Unit 5.0Network Parameters andDevices** 5.1 Network performance parameters Band Width, Noise, Distortion Attenuation, Bit rate and Baud rate, latency, Throughput, Bandwidth-delay product, jitter 5.2 Network devices:Repeater,Hub,Switch,Bridge,Router,Brouter,Access Point,Gateway,RS 232,RJ 45 andRJ11,NIC,Bluetooth, Wi-Fi IEEE 802.11	• Differentiate between the functions of Hub and Switches. • Differentiate between the functions of Router and Gateway.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5   **Suggested Sectional Work (SW):**

     a. **Assignments:**
         i. Identify different network devices used in computer networking.
         ii. Write the advantage and disadvantage of hub over switch.
         iii. Write the function of the given networking device.
         iv. Write the difference between it rate and baud rate.
     b. **Mini Project:**
         i. Develop a network using different communication device.
     c. **Other Activities (Specify):**
         i. Prepare chart to show the functions of different networking devices.
         ii. Prepare an Internet based survey on the technical specifications of various types of networking devices.

     Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

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I)   **Suggested Specification Table (For ESA of Classroom Instruction):**

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	Basics of Computer Networking	5	7	2	14
II	Reference Models for Network Implementation	4	5	7	16
III	Line Coding and Switching	4	5	5	14
IV	Network Protocol and Applications	2	5	6	13
V	Networking Parameters and Devices	3	5	5	13
	Total	**18**	**27**	**25**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J)   **Suggested Specification Table (For ESA of Laboratory Instruction*):**

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Establish a network to connect computers/nodes in the given topology.	15	10	05
LE2.1	Prepare a layout demonstrating data transfer aspects as per TCP/IPI model between computing devices.	15	10	05
LE3.1	Measure the signal parameters of Unipolar coded signal.	15	10	05
LE3.2	Measure the signal parameters of Manchester coded and decoded signal.	15	10	05
LE3.3	Install and test the working function of the given modem.	15	10	05
LE4.1	Implementing an IP Addressing Scheme for the given type of network.	15	10	05
LE4.2	Write a program for demonstrating: - 1. TELNET 2. FTP 3. PING	15	10	05
LE4.3	Install and configure a network adapter of the given computer system and network.	15	10	05
LE5.1	Prepare cross-wired cable and straight through cable using clamping tool.	15	10	05
LE5.2	Install, configure and test the given hub for networking.			
LE5.3	Install, configure and test the given switches for networking.	15	10	05
LE5.4	Install, configure and test the given Routers for networking.	15	10	05
LE5.5	Test the various basic network command and network configuration commands.	15	10	05
LE5.6	Install the LAN of 10 computers.	15	10	05
LE5.7	Prepare RJ-45 cable.	15	10	05

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend : PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of 30 Marks as per assessment scheme

K)   **Suggested Instructional/Implementation Strategies:**

1. Improved Lecture

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2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L)   **Suggested Learning Resources:**

     (a)   **Books** :

S. No.	Titles	Author	Publisher	Edition & Year
1	Data communication and Networking	Forouzan, Behrouz,	Tata Mcgraw Hill, New Delhi	4th edition 2017 ISBN-978-0070634145, latest edition
2	Networking Essential – Training Guide	Casad ,Joe and Dan Newland,	(MCSE, MCT) Tech Media, New Delhi	1997 or latest edition
3	Networking Essential – Study Guide	James Chellis	Techmedia Publication, New Delhi	**2000** or latest edition
4	Computer Networks	Andrew S Tanenbaum	Pearson education India,New Delhi	5th edition 2013 ISBN 978-9332518742, latest edition
5	Introduction to Data Communications and Networking	Tomasi, W.	Pearson Education, New Delhi, India	2007 ISBN : 9788131709306 or latest edition
6	Data and Computer Communications	Stallings, W.	Prentice Hall India,	10 thEdition, 2013, ISBN: 9780133506488 Or latest edition

     (b)   **Open source software and website address**:

1. http://www.rpsinstitutions.org/downloads/lab%20manual/cnlab.pdf
1. https://www.tutorialspoint.com/data_communication
2. https://sjce.ac.in/wp-content/uploads/2018/01/CCNA-**lab-Manual.**pdf
3. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf
4. https://doc.lagout.org/network/Data%20Communications%20and%20Networking%20By%20Behrouz%20A.Forouzan.pdf
5. http://www.studytonight.com/computer-network/tcp-ip-reference-model
6. http://www.studytonighty.com/computer-network/network-topology-types
7. http://www.tcpipguide.com/free/t_connectionorientedandconnectionlessprotocols.htm
8. https://www.vidyarthiplus.com/vp/attachment.php?aid=43525
9. http://www.myreadingroom.co.in/notes-and-studymaterial/68-dcn/719-different-line-coding-techniques.html
10. https://www.cambridgeinternational.org/Images/285023-topic-3.2.1-protocols-9608-.pdf

M)   **List of Major Laboratory Equipment and Tools:**

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Multi Level Cable Tester, different length and type (Twisted Pair, Co-axial, Optical fiber) of LAN cable, RJ11 and RJ45 Connectors, I/O Box, Clipping Device	Use for BNC indicator, 10 BASE T, Token Ring with specification of ATandT 258A, EIA/TIA 568	LE1.1, LE5.1 to LE5.7
2	ADSL and DSL Modem with, Land Line phone and internet connection	As per the availability.	LE3.3
3	Repeater, Hub, switches, gateways and routers.	As Per Latest Specification devices	LE5.2 to LE5.6
4	Manchester coding and decoding trainer kit	On board Manchester coding and decoding circuit On board digital data generator in RZ and NRZ format With built-in power supply On board bit clock recovery	LE3.2
5	Line coding and decoding trainer kit	Encoding Type : NRZ Level, NRZ Mark, RZ,Manchester, Manchester Mark Decoding : Data O/P 1(NRZ Mark and Manchester Mark) Data O/P 2(RZ and Manchester),Supply Voltage (Board) : +9V / DC ,Supply current : 100 mA (Minimum),Interface connectors : 2mm socket	LE3.1

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N)   Mapping of POs & PSOs with COs:

Course Outcomes (COs)		PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1	Explain the concepts of Computer networking	2	3	3	3	2	2	1	1	2	1	3	2
CO-2	Install various communication devices of networking for data communication	2	3	3	3	2	2	1	1	2	1	3	3
CO-3	Describe Reference models of computer network with its function in each layer.	2	2	2	2	1	1	1	1	2	1	2	2
CO-4	Analyze the different network Protocols	2	3	3	3	1	1	1	1	2	1	2	2
CO-5	Distinguish the different types of Line coding and Switching Techniques	2	3	2	3	1	1	1	1	2	1	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

O)   **Course Curriculum Map:**

POs & PSOs No.	COs No.& Titles		SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1	Explain the concepts of Computer networking	SO1.1,SO1.2 SO1.3, SO1.4	LE1.1	Unit 1.0 Basics of Computer Networking 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 1.7, 1.7.1, 1.7.2, 1.8. 1.8.1, 1.8.2, 1.8.3, 1.8.4, 1.8.5	As mentioned in relevant page number
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2	Install various communication devices of networking for data communication	SO2.1,SO2.2, SO2.3, SO2.4	LE2.1	Unit 2.0 Reference Models for Network Implementation 2.1, 2.2, 2.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3	Describe Reference models of computer network with its function in each layer.	SO3.1, SO3.2 SO3.3, SO3.4	LE3.1, LE 3.2, LE3.3	Unit: 3.0 Line Coding and Switching 3.1, 3.2, 3.3, 3.4, 3.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4	Analyze the different network Protocols	SO4.1, SO4.2, SO4.3, SO4.4,	LE4.1, LE4.2, LE4.3,	Unit 4.0 Network Protocol and Applications 4.1,4.2,4.3,4.4,4.5,4.6,4.7	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5	Distinguish the different types of Line coding and Switching Techniques	SO5.1, SO5.2, SO5.3,	LE5.1, LE5.2, LE5.3, LE5.4, LE5.5, LE5.6, LE5.7	Unit 5.0Network Parameters and Devices 5.1 ,5.2	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A)	Course Code	: 2028673(037)
B)	Course Title	: Entrepreneurship Development and Management
C)	Pre- requisite Course Code and Title	:
D)	Rationale	:

Our fast growing economy provides ample opportunities for diploma engineers to succeed in entrepreneurship. Diploma engineers can be their own masters and job provider to others by starting their service industry/assembly/marketing/consultancy/manufacturing enterprises. As entrepreneurship requires distinct skill set which may not be developed while undergoing technical subjects, a separate course has been introduced for the same. This course aims at developing competencies in the diploma engineer for becoming an intrapreneur or a successful entrepreneur. After successfully completing this course students who develop qualities of successful entrepreneur can set up their own manufacturing industry/service industry/business/startup or be self employed and those who prefer job can become intrapreneur and share profits with their company.

E)   **Course Outcomes**

CO-1   **Demonstrate traits of a successful intrapreneur/entrepreneur**

CO-2   **Analyse the level of achievement motivation by preparing one's own portfolio.**

CO-3   **Innovate products and services using creativity techniques.**

CO-4   **Manage critical resources from support institutions.**
CO-5   **Prepare sustainable small business plans.**

F)   **Scheme of Studies:**

S. No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total credit L+T+P/2
1	Mechanical Engineering	2028673(037)	Entrepreneurship Development and Management	3	-	-	3

Legend: L - Lecture   T - Tutorial   P - Practical

G)   **Scheme of Assessment:**

S. No	Board of Study	Course code	Course Title	Schemes of Examination					
				Theory			Practical		Total
				ESE	CT	TA	ESE	TA	Marks
1	Mechanical Engineering	2028673 (037)	Entrepreneurship Development and Management	70	30	30	-	-	130

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H)   **Course-Curriculum Detailing:**

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1   **Demonstratetraits of a successful intrapreneur/entrepreneur**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Select intrapreneurship orentrepreneurship as acareer based on the qualities possessed by an individual. SO1.2 Identify various avenues of entrepreneurship for diploma engineers. SO1.3 Demonstrate qualities of successful intrapreneur /entrepreneur. SO1.4 Explain various steps in establishment of enterprise. SO1.5 Select an area of business opportunity as per your interest.		**Unit 1.0 Characteristics of entrepreneurs** 1.1 Concept of entrepreneur and intrapreneur 1.2 Benefits of becoming an intrapreneur/ entrepreneur. 1.3 Scope of entrepreneurship in local and global market. 1.4 Planning for establishment of an enterprise. 1.5 Traits of successfulintrapreneur/ entrepreneur and passion, initiative, independent decision making, team work, assertiveness, persuasion, persistence, information seeking, commitment to work contract etc. SW analysis. Team work simulation. 1.6 Trait of successful entrepreneur: calculated risk taking. Risk taking simulation exercise. 1.7 Business opportunity Guidance	• History of entrepreneurship. • Definition of entrepreneurship • Social entrepreneurship

SW-1   **Suggested Sessional Work (SW):**

a. **Assignments:**
   i. Identify existing needs of the institute/college and convert them into business opportunity.
   ii. Enumerate characteristics of assigned first generation successful entrepreneurs, intrapreneurs, managers by preparing a presentation.
   iii. Analyse the reasons for success and failure of the assigned entrepreneurs by preparingppt on the basis of news, articles, reviews, video etc.

b. **Mini project:**
   i. Interviewing few local entrepreneurs and prepare a collage on "Traits of successful entrepreneurs".
   ii. Identify traits to be developed in you for becoming a successful entrepreneur based on your strength and weakness analysis and submit an action plan to develop the same.
   iii. Organise "best from waste" competition.

c. **Other Activities:**
   i. Identify your hobbies and interests and convert them into business idea.
   ii. Organise seminar on history of entrepreneurship, Definition and selected case studies of social entrepreneurship.

CO-2   Analyse the level of achievement motivation by preparing one'sown portfolio.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO2.1 Explain the concept of achievement motivation.
SO2.2 Assess level of need for Achievementin the individual through different tools.
SO2.3 Prepare an action plan for enhancing need for achievement.
		Unit 2.0 Motivation Management
		2.1 Motives, motivation and motivational cycle.
		2.2 Concept of Need for Achievement.
		2.3 Need for Achievement assessment through various tools.
		  • Ring toss game
		  • Boat making exercise
		  • Building block exercise
		  • TAT stories
		  • Who am I?
		2.4 Interpretation and action plan for self development.
			• Kakinada experiment Techno-preneurship.

SW-2   Suggested Sessional Work (SW):

   a. Assignments:
     i. Prepare a portfolio based on achievement motivation exercise and tasks.

   b. Mini project:
     i. Prepare a report on need for achievement exercises.
     ii. Develop achievement motivation field exercises.

   c. Other Activities:
     i. Prepare a plan for development of achievement motivation and execute it.
     ii. Develop case studies on Techno-preneurship.
     iii. Prepare a report on Kakinada experiment.

CO-3   Innovate products using creativity techniques.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Elucidatethe use creativity techniques for entrepreneurs. SO3.2 Improve a chosen product using brainstorming technique. SO3.3 Differentiate between creativity and innovation. SO3.4 Apply concept of product life cycle for conceiving a project. SO3.5 Design a product		**Unit 3.0 Management of Creativity.** 3.1 Creativity: Divergent thinking, creativity techniques. 3.2 Innovation, types and applications 3.3 Product life cycle, New product development process. Product development and innovation through creativity and innovation.	• Check list of questions. • Six thinking hats. • Case study of innovative first generation entrepreneur. • Schemes and incentives for innovation. • Innovative solutions for social problems.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
using new product development process.			

SW-3 Suggested Sessional Work (SW):

    a. **Assignments:**
        i. Use the assigned creativity technique for improvement of product characteristic.
        ii. Use the assigned creativity technique for improvement of service process characteristic.

    b. **Mini project:**
        i. Apply innovative practices in different process of an enterprise.

    c. **Other Activities:**
        i. Prepare a prototype of a creative solution to industrial/ social problem.
        ii. Organise seminar on Schemes and incentives for innovation, Innovative solutions for social problems and Kakinada experiment.

CO-4 Managecritical resources from support institutions.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Select appropriate form of business organization for enterprise SO4.2 Identify entrepreneurship support institutionsfor technical/ marketing and finance. SO4.3 Explain salient features of entrepreneurship promotion schemes of centre and state. SO4.4 Prepare a marketing mix plan for identified industry. SO4.5 Develop a materials management plan. SO4.6 Develop a human resource plan.		**Unit 4.0 Critical Resources** 4.1 Forms of business organization: Proprietorship, Partnership, Cooperative, Private, Public Ltd Company, Section 8 company, LLP 4.2 Institutional Support for entrepreneurship: MSMESI, CED, DTIC, CITCON, CSIDC, LUN, NSIC, KVIC, NABARD, Banks, SIDBI 4.3 Entrepreneurship promotion schemes of centre and state. 4.4 Marketing Mix, Market survey for project identification 4.5 Inventory control, vendor development, material movement, store management. 4.6 Manpower plan, hiring process, compensation, performance appraisal.	• Establishment procedure of Proprietorship, LLP, Cooperative, Section 8 company,LLPFactory Act, Labour Laws, GST,

SW-4 Suggested Sessional Work (SW):

    a. **Assignments:**

i.   Examine suitability of different forms of business organization for the given project and prepare a presentation for the same.
ii. Conduct a market survey and prepare a report along with marketing mix plan for the given project.
iii. Prepare materials management strategy for a business or manufacturing unit and submit as areport.
iv. Prepare a man power plan chart and job specifications for identified positions.

b. Mini project:
i.   Explore facilities extended by support institutions to entrepreneurs for marketing of the given situation.
ii. Investigate facilities extended by support institutions to entrepreneurs for technical support of the given situation.
iii. Identifyfacilities extended by support institutions to entrepreneurs for financial support of the given situation

c. Other Activities:
i.   Visit the assigned agencies engaged in institutional support for entrepreneurship and make a report.
ii. For your selected project decide a unique name of the enterprise, logo, signboard, letterhead andpamphlet.
iii. Organise a seminar on establishment procedure of proprietorship, LLP, cooperative, section 8 company, factory act, labour laws and GST.

CO-5   Preparesustainable small business plans.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO5.1 Prepare business plan/techno economic feasibility report. SO5.2 Calculate and comment on breakeven point for given project. SO5.3 Explain financing of startups.		**Unit 3.0 Sustainable business plan** 5.1 Format of business plan/techno-economic feasibility report. 5.2 Demand and annual production target based on market survey. 5.3 Outline production/service process. 5.4 Land, building and machinery requirement. 5.5 Power,utilities and raw material requirement. 5.6 Fixed capital, Working capital, Subsidy and Cost of Project. 5.7 Means of finance, calculation of interest. 5.8 Profitability analysis, Break-even point.	• Techno-economic feasibility report of MSME. • Startup process. • Angel Investors. • Venture capitalist. • Incubators.

SW-5   Suggested Sessional Work (SW):

a. Assignments:
i.   Describe the procedure of registration and availing of facilities from the assigned support institution.
ii. Prepare a process plan for the selected project.

b. Mini project:

    i.   Prepare a marketing plan for the assigned project.
    ii.   Prepare a financial plan for the assigned project.
    iii. Prepare a technical feasibility plan for the assigned project.
    iv. Prepare a techno-economical feasibility report of the assigned project.

c. Other Activities:
    i.   Analyse a case study on startups focusing on financing from angel investor and venture capitalist.
    ii. Organise seminar on Starup process, Angel investors, Venture Capitalist and Incubators

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I)   Suggested Specification Table (For ESA of Classroom Instruction):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	Characteristics of entrepreneurs	2	4	8	14
II	Motivation Management	2	2	6	10
III	Management of Creativity and Innovation	2	4	8	14
IV	Resource Management	2	4	10	16
V	Sustainable Business Plan	2	4	10	16
	Total	10	18	42	70

Legend: R: Remember, U: Understand, A: Apply and above

J)   Suggested Specification Table (For ESA of Laboratory Instruction*):Not Applicable

K)   Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Field Trips
6. Portfolio Based Learning
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
9. Brainstorming

L)   Suggested Learning Resources:

(a)   Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Entrepreneurial Development	Desai Vasant	Himalaya Publishing House	Mumbai/2017 ISBN 978 93 5097 383 7
2	Starting your own business, step by step Blue print for the First – time Entrepreneur	Harper Stephen C.	Mc Craw-Hill	2003 ISBN13: 9780071410120
3.	The Business Planning GUIDE	H.Bangs David	Upstart Publishing Company in Chicago	978-0793154098
4	Entrepreneurship	Gupta Dr.C.B.	Sultan Chand & Sons	9788180548185

S. No.	Titles	Author	Publisher	Edition & Year
	Development in India	Shriniwasa NP		
5	Entrepreneurship Development	Khanka Dr.S.S.	S.Chand New Delhi	ISBN 81 219 1801 4
6	Entrepreneurship Development and small Business Enterprises	Charantimath M.	Pearson Edu.Soc. INDIA	2013/ISBN 13 978 8131 762264
7.	Entrepreneurship Development	Sharma Sangita	PHI, DELHI	ISBN 978 81 203 5270 4

(b)   **Open source software and website address**:

1. Free e books: https://www.free-ebooks.net/book-list/entrepreneurship
2. Startups:https://inc42.com/startups/?utm_source=top-menu&utm_medium=website&utm_campaign=menu
3. Indian Tech Startup funding report: https://pages.inc42.com/annual-indian-tech-startup-funding-report-2017/?utm_source=top-menu&utm_medium=website&utm_campaign=menu
4. Project profile: https://my.msme.gov.in/MyMsmeMob/MsmeProjectProfile/Home.htm
5. Project profile: http://www.dcmsme.gov.in/publications/pmryprof/pjseries.html
6. Project profile http://www.dcmsme.gov.in/reports/ProjectProfile.htm

M)   **List of Major Laboratory Equipment and Tools: Not Applicable**

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N)   **Mapping of POs & PSOs with COs:**

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Demonstrate traits of a successful intrapreneur/entrepreneur.	-	3	-	-	2	2	2	2	2	2	-	-
CO-2 Analyse the level of achievement motivation by preparing one's own portfolio.	-	3	-	-	2	2	2	2	2	2	-	-
CO-3 Innovate products using creativity techniques.	-	3	-	-	2	2	2	2	2	2	-	-
CO-4 Manage critical resources from support institutions.	-	3	-	-	2	2	2	2	2	2	-	-
CO-5 Prepare sustainable small business plans.	-	3	-	-	2	2	2	2	2	2	-	-

Legend: 1 – Low, 2 – Medium, 3 – High

O)   Course Curriculum Map:

POs & PSOs No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-2,5,6,7,8, 9,10	CO-1 Demonstrate traits of a successful intrapreneur/entrepreneur.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit 1.0 Characteristics of entrepreneurs 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7	As mentioned in relevant page number
PO-2,5,6,7,8, 9,10	CO-2 Analyse the level of achievement motivation by preparing one's own portfolio.	SO2.1 SO2.2 SO2.3		Unit 2.0 Motivation Management 2.1, 2.2, 2.3, 2.4	
PO-2,5,6,7,8, 9,10	CO-3 Innovate products using creativity techniques.	SO.3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit 3.0 Management of Creativity and Innovation 3.1, 3.2, 3.3	
PO-2,5,6,7,8, 9,10	CO-4 Manage critical resources from support institutions.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6		Unit 4.0 Resource Management 4.1, 4.2, 4.3, 4.4,4.5,4.6	
PO-2,5,6,7,8, 9,10	CO-5 Prepare sustainable small business plans.	SO5.1 SO5.2 SO5.3		Unit 5.0 Sustainable Business Plan 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

A)	Course Code	: 2028681(028)
B)	Course Title	: Embedded System and VLSI
C)	Pre-requisite Course Code and Title	: Microcontroller and its applications and digital electronics

D)   Rationale   :

To add luxury to any product requires fully automation and for that we need embedded system, where we don't need user intervention. By learning this course students can develop their own embedded system which is application specific to solve given real time problem by using open source platform. Thus this course is an important course for students who want to work in the automation sector of electronic industry. This course will also enable the students to acquire the basic skills to develop codes for VLSI circuits through VHDL programming

E)   Course Outcomes:

CO-1   Maintain microcontroller based system.

CO-2   Select microcontroller for different application.

CO-3   Interface hardware for given application.

CO-4   Use the concepts of VLSI.

CO-5   Develop VHDL Programs related to Combinational circuit & Sequential circuits.

F)   Scheme of Studies:

S. No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total credit L+T+P/2
1	E&TC Engineering	2028681(028)	Embedded System and VLSI	2	-	1	3
2	E&TC Engineering	2028691(028)	Embedded System and VLSI (Lab)	-	2	-	1

Legend: L - Lecture   T - Tutorial   P - Practical

G)   Scheme of Assessment:

S. No	Board of Study	Course code	Course Title	Schemes of Examination					
				Theory			Practical		Total
				ESE	CT	TA	ESE	TA	Marks
1	E&TC Engg.	2028681 (028)	Embedded System and VLSI	70	30	30	-	-	130
2	E&TC Engg.	2028691 (028)	Embedded System and VLSI (Lab)	-	-	-	30	50	80

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H)   Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.
Convert unit of the given physical quantity from one unit system to other.

CO-1   Maintain microcontroller based system.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define basic concept of embedded system SO1.2 Explain Characteristics of embedded system. SO1.3 Compare different Operating Systems used for embedded system designing	LE1.1 Verify atleast three characteristics of embedded system LE1.2 Identify the types of operating system LE1.3 Identify atleast two characteristics of real time operating system.	**Unit 1.0 Overview of Embedded System:** 1.1 Embedded System Characteristics 1.2 Examples: Washing Machine, Chocolate Vending Machine, Room Temperature Controller 1.3 Operating System(OS): Types of OS, Types of Mobile OS 1.4 Characteristics of Real Time Operating System	• Interconnection of embedded microcomputer and supporting hardware elements.

SW-1   Suggested Sessional Work (SW):

    a. **Assignments:**
        i.   List various characteristics of Embedded System.
        ii. Identify the applications of embedded system.

    b. **Mini Project:**
        i.   Make a list of 10 types of mobile operating system and compare them on any two characteristics.

    c. **Other Activities (Specify):**
        i.   List the differences between an operating system and an operating system kernel
        ii. Prepare a presentation on embedded system.

CO-2   Select appropriate family of microcontroller for different applications.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Compare different micro controllers used for embedded system designing SO2.2 Describe AVR microcontroller with its functional diagram SO2.3 Describe block diagram of Atmega 8. SO2.4 identify pins of ATmega 8 SO2.5 Introduce time delay using Timers and counters. SO2.6 Describe Operation of Analog to Digital Converter. SO2.7 Describe Basic peripheral circuits connection required for the operation of	LE2.1 Identify the pins of PIC & AVR Microcontrollers. LE2.2 Identify the pins of ARM &ATmega 8 Microcontrollers. LE2.3 Check the running of TIMER0 of ATmega8. LE2.4 Write a simple code for Atmega8 which sets up Timer0 for 1ms at 16Mhz clock cycle. LE2.5 Burn 16MHZ bootloader using ISP programmer.	**Unit2.0 8-bit Microcontrollers Architecture (Atmega 8,AVR)** 2.1 Microcontroller Types: PIC, AVR, ARM: features and applications 2.2 AVR microcontroller: Architecture 2.3 Internal Architectural ,Block diagram of controller (Atmega 8) 2.4 Functions of each pins of ATmega 8 2.5 Configuration of Two 8-bit and One 16-bit Timers and Counters 2.6 6-channel ADC Working 2.7 Essential Peripheral circuits: Crystal Circuit, Power supply, Oscillator Circuit 2.8 Initial programming configurations of Atmega8:	• Compare Atmega8 and 8051.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
8 bitmicrocontroller (ATmega8) SO2.8 Explain basic circuit and code required for programming (Boot Code)		port, counter, timer 2.9 Bootloader Circuit 2.10 ISP of Atmega 8	

SW-2   Suggested Sessional Work (SW):

a. **Assignments:**
   i. List the features of different types of microcontroller.
   ii. Compare features of AVR, PIC and ARM micro controllers
   iii. Compare timer 0 and timer 2 of Atmega8.

b. **Mini Project:**
   i. Prepare a project on Embedded Home Security System
   ii. Interface ADC devices to Microcontroller.

CO-3   Interface relevant hardware for given application.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain working of open source embedded development board using block diagram SO3.2 Identify pins of embedded development board. SO3.3 Describe programming of embedded development board SO3.4 Make a Basic Circuit of embedded development Board. SO3.5 Interface Serial Port with embedded development board SO3.6 Explain concept of input and output port of embedded development	LE3.1 Interface RF Tx/RF Rx with Arduino LE3.2 Interface 16x2 LCD and Display "HELLO WORLD". LE3.3 Interfacing LED,Switch,7seg LED and its Code LE3.4 Build Digital thermometer using LM35 and LCD 16x2. LE3.5 Interface DC Motor and write a code for it	**Unit 3.0Open Source Embedded Development Board (Arduino)** 3.1 Functional Block Diagram of Arduino board 3.2 Functions of each Pin of Arduino board Arduino Development Board diagram (including different blocks only): IDE, I/O Functions, Looping Techniques, Decision Making Techniques 3.3 Describe the features of open source tool used for programming a development board 3.4 Programming of an Arduino (Arduino ISP) 3.5 Arduino Boot loader 3.6 Serial Protocol (serial port Interfacing) 3.7 Initialization of Serial Port using Functions 3.8 Basic Circuit For Arduino 3.9 Interfacing and I/O Concept 3.10 Interfacing LED,Switch,7seg LED its and Code	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
board (Arduino Interfacing Concept) SO3.7 Explain Interfacing of DC motor with programming.		3.11 Interfacing DC motor and its Code	

SW-3   Suggested Sectional Work (SW):

    a. Assignments:
        i.   Explain different component present on arduino board.

    b. Mini Project:
        i.   Make Line-Follower Robot using Arduino
        ii. Code for Home automation and its Control

CO-4   Use the concepts of VLSI.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain VLSI technology in brief SO4.2 Describe the fabrication process SO4.3 Apply the stick diagram rules	LE4.1 Estimate the size of the necessary masks used for fabrication. LE4.2 Construct the N-Well process for CMOS Fabrication. LE4.3 Construct the P-Well process for CMOS Fabrication LE4.4 Draw the STICK diagram for different gates in VLSI design layout.	**Unit-4.0 Introduction to VLSI** 4.1. VLSI Technology-History, Advantages, Disadvantages & Applications 4.2. Steps for Fabrication on Silicon wafer 4.3. CMOS Fabrication process: 4.4. STICK diagram & its design Rules	• Difference between VLSI and embedded systems?

SW-4   Suggested Sectional Work (SW):

    a. Assignments:
        i.   List the various benefits of VLSI Technology.
        ii. Draw and explain the stick diagram of PMOS, NMOS and CMOS.

    b. Mini Project:
        i.   Prepare a chart of stick diagram notation.

    c. Other Activities (Specify):
        i.   Indian Contribution to VLSI Technologies.
        ii. Prepare a chart on the process involved of the fabrication of IC.

CO-5   Develop VHDL Programs related to Combinational circuit & Sequential circuits

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Explain VHDL Programming steps SO5.2 Develop VHDL Programs for logic gates SO5.3 Develop VHDL Programs for Combinational circuit SO5.4 Develop VHDL program for Sequential Circuit	5.1 Write a VHDL code for logic gates 5.2 Write VHDL programs for the following circuits, check the wave forms a. Half adder b. Full adder 5.3 Write a VHDL program for a different FLIP-FLOP and check the wave forms	**Unit 5.0 VHDLProgramming** 5.1 VHDL Design: Entity and Architecture Declaration 5.2 VHDL modeling –Dataflow, behavioral, structural 5.3 Logic operations viz. AND,OR, NOR,NAND,NOT,EXOR, EXNOR etc. 5.4 Combinational circuit Adder and substractor 5.5 Basic sequential circuits- SR , D , RS, T, JK Flip flops	• List the different application of Combinational circuit and sequential circuit

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5   Suggested Sectional Work (SW):

   a. **Assignments:**
      i. Comparison among Dataflow, behavioral, structural VHDL modeling
      ii. VHDL divides the description of a module into an Entity and an Architecture section
      iii. Realize a full adder using VHDL code
      iv. Realize D and T flip flop using VHDL code

   b. **Mini Project:**
      i. Design any circuit on all the three modeling style.

   c. **Other Activities (Specify):**
      i. Prepare a Presentation on VHDL design.
      ii. Prepare a Presentation on VHDL modeling.

   Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I)   Suggested Specification Table (For ESA of Classroom Instruction):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	Overview of Embedded System	3	3	8	14
II	8-bit Microcontrollers Architecture (Atmega8,AVR)	2	4	8	14
III	Open Source Embedded Development Board (Arduino)	2	2	10	14
IV	Introduction to VLSI	2	3	9	14
V	VHDL Programming	2	3	9	14
Total		11	15	44	70

Legend: R: Remember, U: Understand, A: Apply and above

J)   **Suggested Specification Table (For ESA of Laboratory Instruction*):**

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
1.1	Verify atleast three characteristics of embedded system	15	10	5
1.2	Identify the types of operating system	15	10	5
1.3	Identify atleast two characteristics of real time operating system	15	10	5
2.1	Identify the pins of PIC & AVR Microcontrollers.	15	10	5
2.2	Identify the pins of ARM &ATmega 8 Microcontrollers	15	10	5
2.3	Check the running of TIMER0 of ATmega8	15	10	5
2.4	Write a simple code for Atmega8 which sets up Timer0 for 1ms at 16Mhz clock cycle.	15	10	5
2.5	Burn 16MHZ bootloader using ISP programmer	15	10	5
3.1	Interface RF Tx/RF Rx with Arduino			
3.2	Interface 16x2 LCD and Display "HELLO WORLD".	15	10	5
3.3	Interfacing LED,Switch,7seg LED and its Code	15	10	5
3.4	Build Digital thermometer using LM35 and LCD 16x2	15	10	5
3.5	Interface DC Motor and write a code for it	15	10	5
3.6	Motor Driver L293D, IR Sensor	15	10	5
4.1	Estimate the size of the necessary masks used for fabrication	15	10	5
4.2	Construct the N-Well process for CMOS Fabrication	15	10	5
4.3	Construct the P-Well process for CMOS Fabrication	15	10	5
4.4	Draw the STICK diagram for different gates in VLSI design layout	15	10	5
5.1	Write a VHDL code for logic gates	15	10	5
5.2	Write VHDL programs for the following circuits, check the wave forms a. Half adder b. Full adder	15	10	5
5.3	Write a VHDL program for a different FLIP-FLOP and check the wave forms	15	10	5

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend :   PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of 30 Marks as per assessment scheme

K)   **Suggested Instructional/Implementation Strategies:**

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning

9.   Role Play
10.   Demonstration
11.   ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12.   Brainstorming
13.   Others

L)   **Suggested Learning Resources:**

      (a)   **Books** :

S. No.	Titles	Author	Publisher	Edition & Year
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Janice, Gelispe and Mckinlay, Roline D.	Pearson, Delhi, ISBN: 9788177589030	2nd edition, 2008
2	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill Education, New Delhi, ISBN: 9780070585959	2011
3	Arduino Programming in 24 hours	Richard Blum	Pearson Education ISBN : 978-9332552432	1 Jan 2015
4	Arduino Projects for Engineers	NeerparajRai	BPB Publications ISBN: 978-8183335973	15 July 2016
5	Digital Design	M. Morris Mano, Michael D. Ciletti	Pearson Education India, ISBN: 978-9353062019	18 May 2018, 6th edition
6	Introduction to VLSI circuits and systems	John P Uyemura	Wiley, ISBN: 978-8126509157	Jan 2006

      (b)   **Open source software and website address**:

1. www.academia.edu/22050921/VHDL_**Lab_Manual**
2. www.tutorialspoint.com/vlsi_design/vlsi_design_vhdl_introduction.html
3. www.vvitengineering.com/lab/odd/EC6711-Embedded-Lab-**Manual**-final.pdf
4. www.engr.colostate.edu/~sudeep/teaching/hardwaresoftware-design-of-embedded-systems/assignments-project/
5. www.ycetnnl.edu.in/downloads/files/n532957f829d24.pdf
6. www.slideshare.net/TrijitMallick/vlsi-designfabrication?qid=3df11c7a-e3ff-4a38-a916-d2a5180904f0&v=&b=&from_search=2

M)   **List of Major Laboratory Equipment and Tools:**

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Microcontroller kit (8051,AVR/PIC/ARM):.	Single board systems with minimum 8K RAM,ROM memory with battery back up,16X4, LCD display,7-segment Display, PC keyboard interfacing facility, 4X4 matrix keyboard, cross c-compiler, USB, interfacing facility with built in power supply	All
6	Desktop PC with microcontroller simulation software	Processor i7, Ram-8GB, HD-1TB	All
7	VLSI trainer kit along with peripherals such as switches, keyboard, LEDs, seven segment display	-	4 & 5
8	Arduino Board	-Arduino Uno/Arduino Mega/Nano	3.1 to 3.9

N)   **Mapping of POs & PSOs with COs:**

Course Outcomes (COs)		Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
		PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1	Maintain microcontroller based system	2	2	1	3	2	1	1	1	1	2	2	2
CO-2	Select microcontroller for different application.	2	2	1	3	2	1	1	1	1	2	2	2
CO-3	Interface hardware for given application	2	2	1	3	2	1	1	1	1	2	2	2
CO-4	Use the concepts of VLSI	2	2	1	3	2	1	1	1	1	2	2	2
CO-5	Develop VHDL Programs related to Combinational circuit & Sequential circuits	2	2	1	3	2	1	1	1	1	2	2	2

Legend:1 – Low, 2 – Medium, 3 – High

O)   **Course Curriculum Map:**

POs & PSOs No.	COs No.& Titles		SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1	Maintain microcontroller based system	SO1.1 SO1.2 SO1.3	LE1.1 LE1.2 LE1.3	Unit 1.0 1.1, 1.2, 1.3,1.4	As mentioned in relevant page number
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2	Select microcontroller for different application.	SO2.1 - SO2.8	LE2.1 LE2.2 LE2.3 LE2.4 LE2.5	Unit 2.0 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3	Interface hardware for given application	SO3.1 - SO3.7	LE3.1 - LE 3.6	Unit 3.0 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10 3.11	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4	Use the concepts of VLSI	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2 LE4.3 LE4.4	Unit 4.0 4.1,4.2,4.3,4.4	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5	Develop VHDL Programs related to Combinational circuit & Sequential circuits	SO5.1 SO5.2 SO5.3 SO5.4	LE5.1 LE5.2 LE5.3	Unit 5.0 5.1,5.2,5.3,5.4,5.5	

Legend:CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A)	Course Code	:	**2028682(028)**
B)	Course Title	:	**Internet of Things (IoT)**
C)	Pre-requisite Course Code and Title	:	Computer Network, Communication-I and II, Instrumentation and Measurements
D)	Rationale	:	

Internet of Things (IoT) is presently an important technology and the backbone of Industry 4.0 standards. IoT has different applications ranging from civilian to defense sectors which includes agriculture services, space, health care, manufacturing, construction, water distribution, academia, medical services, security and law enforcement services, telecommunication and is useful in almost every Industry. Today it is possible to develop different IoT solutions such as shopping system, smart city project, smart road, infrastructure management, SMART grid powder distribution, agriculture, in both urban and rural areas, remote health monitoring and emergency notification systems etc. with very few hardware and little knowledge of the domain. The objective of this course is to impart necessary and practical knowledge of components of Internet of things and develop skills required to build real-life IoT based simple projects and efficiently maintain the IoT based systems.

E)   Course Outcomes:

CO-1   Interpret the functions of basic building blocks of Internet of Things (IoT) systems.

CO-2   Interpret different types of protocol and communication technology used in IoT system.

CO-3   Identify the basic hardware requirement of IoT systems.

CO-4   Interface sensors with IoT devices.

CO-5   Summarize the different application areas of IoT.

F)   Scheme of Studies:

S. No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total credit L+T+P/2
1	E&TC Engineering	2028682(028)	Internet of Things (IoT)	2	-	1	3
2	E&TC Engineering	2028692(028)	Internet of Things (IoT) (Lab)	-	2	-	1

Legend: L - Lecture   T - Tutorial   P - Practical

G)   Scheme of Assessment:

S. No	Board of Study	Course code	Course Title	Schemes of Examination					Total Marks
				Theory			Practical		
				ESE	CT	TA	ESE	TA	
1	E&TC Engg.	2028682 (028)	Internet of Things (IoT)	70	30	30	-	-	130
2	E&TC Engg. Engineering	2028692 (028)	Internet of Things (IoT) (Lab)	-	-	-	30	50	80

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H)   Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

Convert unit of the given physical quantity from one unit system to other.

CO-1   Interpret the functions of basic building blocks of Internet of Things (IoT) systems.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Identify functions of different building block of IoT system. SO1.2 Explain role of IoT in present and future market place. SO1.3 List the key features of IoT systems. SO1.4 Describe the functions of the given component of IoT systems.	LE1.1 Identify the different sections of IoT Kit. LE1.2 Differentiate between IoT and M2M connections.	**Unit 1.0 Overview of IoT** 1.1 IoT conceptual framework, smart and hyper connected devices, IoT and M2M 1.2 IoT architecture, key features of IoT system 1.3 Major components of IoT systems: Physical object, Hardware, communication module, software 1.4 Role and scope of IoT in present and future marketplace 1.5 Development tools and opensource frame work for IoT implementation 1.6 IoT security and privacy issues.	• Summarize the facts that contribute to the emergence of IoT

SW-1   **Suggested Sessional Work (SW):**

     a. **Assignments:**
        i.   Describe the vision of IoT.
        ii.   List similarities and differences between IoT and M2M.
        iii.   Describe security and Privacy issue of IoT system.

     b. **Mini Project:**
        i.   Prepare a report on the technology behind IoT.
        ii.   Prepare a internet based report on IoT communication models.

     c. **Other Activities (Specify):**
        i.   Prepare a PPT on the different IoT Architecture proposed by different companies like ORICAL/CISCO/IBM.

CO-2   Interpret different types of protocol and communication technology used in IoT system.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Describe the types of communication technologies used for IoT. SO2.2 Compare the given type of protocols used for IoT. SO2.3 Differentiate between Bluetooth and nearfield communication. SO2.4 Identify the characteristics of IoT	LE2.1 Establish Bluetooth network for data transfer LE2.2 Establish channel to transfer data on Wi-Fi network. LE2.3 Establish connection to transfer data on the GSM network.	**Unit 2.0 IOT Device and Web Connectivity** 2.1 Technology: wire and wireless, Bluetooth, Wi-Fi, Low energy wireless, low energy Bluetooth and RF, Wi-Fi direct, LTE-A,RFID, Near field communication, GPRS and GSM 2.2 Protocols:NFC, BTLE, ZigBee, WLAN, OSI reference model for IoT **2.3** Software for: data collections,	• Describe the modifications in OSI model for IoT • Describe MQTT in detail

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
data collection system.		data integration, data analysis, real time analysis, application and process extension 2.4 Industry 4.0 standards 2.5 Web communication protocols for connected devices 2.6 Message communication protocols for connected devices Web connectivity for connected devices network using Gateway SOAP, HTTP and WebSocket.	

SW-2   **Suggested Sessional Work (SW):**

     a. **Assignments:**
         i.   Write the modes and data rates of Zigbee IP devices.
         ii.   Compare various communication technologies used for IoT.
         iii.   List applications of SOAP.

     b. **Mini Project:**
         i.   IOT based fire alarm system
         ii.   IOT based intelligent traffic management system

     c. **Other Activities (Specify):**
         i.   Prepare ppt on ITU-T model used for IoT.
         ii.   Prepare seminar on MQTT in detail.

CO-3   **Identify the basic hardware requirement of IoT system.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Classify the sensors for different application. SO3.2 List the basic IoT modules. SO3.3 Describe the functions of the given types of Sensor used in IoT system.	LE3.1 Identify and test the power module of IoT system. LE3.2 Identify and test the sensor module of IoT system. LE3.3 Identify and test the RF module of IoT system. LE3.4 Test the performance of the given type of sensor.	**Unit 3.0 Sensors and other Hardware's for IoT** 3.1 IOT modules: energy module, sensors module, power management module, RF module 3.2 sensors: classifications of sensors, principles and applications of different types of sensors 3.3 Common useful sensors:Temperature sensor, proximity sensor, Touch sensor, Gas, RFID sensors, image sensors, humidity, light, motion, velocity, distance, pressure	• Describe the functions of IoT switch and gateway

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
		3.4 Communication devices: switches, routers, gateways Power management module 3.5 Wearable devices: Watch, bands, rings, shoes, socks, helmet, glasses	

SW-3   Suggested Sectional Work (SW):

    a. **Assignments:**
       i.   Explain the principle and working of touch and temperature sensor with sktechs.
      ii. Define IoT module and explain the different types of IoT module.
      iii. Describe the characteristics of IoT power module.

    b. **Mini Project:**
       i.   Develop IoT based smart parking system using RFID.
      ii. Develop simple IoT based smart street light

    c. **Other Activities (Specify):**
       i.   List the application of various sensors.
      ii. Prepare a presentation on IoT hardware.

CO-4   Interface sensors with IoT devices.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Describe the Arduino Uno chip's pins details. SO4.2 Describe the programming steps of Arduino chip. SO4.3 Describe the programming steps of Raspberry -Pi chip. SO4.4 Classify the IoT devices.	LE4.1 Interface sensors with Arduino for data collection. LE4.2 Interface sensors with Raspberry -Pi for data collection. LE4.3 Develop simple IoT smart home system with the help of Arduino and relay banks.	**Unit 4.0 Interfacing sensors and IoT devices** 4.1 Interaction between software and hardware in IoT devices 4.2 Introduction to ArduinoUnochip, descriptions of pins, technical specification, and Arduinoprogramming 4.3 Implementation of IoT by Raspberry Pi,Interfacing sensor and actuators with Arduino and Raspberry Pi	• Summarize the specification of Arduino family chips

SW-4   Suggested Sectional Work (SW):

a. **Assignments:**
   i.   List the IoT devices.(Any six)
   ii.   Describe the step by step procedure to Interface temperature sensors with Arduino Uno board.

b. **Mini Project:**
   i.   Develop simple IoT based automatic vehicle accident detection and rescue system.
   ii.   Prepare a report on Raspberry -Pi chip and it's programming.

c. **Other Activities (Specify):**
   i.   Prepare ppt on different types of Arduino board.
   ii.   Prepare a survey report on the common sensors used with IoT systems.

CO-5   Summarize the different application areas of IoT.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Explain the concept of IoT in home automation. SO5.2 Explain the concept of IoT in Industrial application. SO5.3 Explain the concept of IoT in Surveillance application.. SO5.4 Explain the concept of IoT in Health care application SO5.5 Explain the concept of IoT in Energy application.	LE5.1 Develop simple home appliances switch control system. LE5.2 Develop simple street light control system based on IoT architecture. LE5.3 Describe the complete design of a parking place display system.	**Unit 5.0 IoT Applications** 5.1 IoT for traffic management. 5.2 IoT enable smart home,Home automation 5.3 Case Studies: Agriculture, Healthcare, Smart city 5.4 Industrial application 5.5 Surveillance application 5.6 Health care application 5.7 Energy application 5.8 Weather monitoring system	• List the similarities in prototype development approach for weather, air-pollution and fire monitoring system.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5   Suggested Sectional Work (SW):

a. **Assignments:**
   i.   Describe design- level complexity levels with an example.
   ii.   List the free and paid cloud platforms available for IoT in our country.
b. **Mini Project:**
   i.   IoT based Water quality management system using Arduino.
   ii.   IoT based gas leakage monitoring system
   iii. IoT based Anti-theft Flooring system using Raspberry pi
c. **Other Activities (Specify):**
   i.   Develop an IoT solution for the vehicle parking of a medium size Mall.

ii.   Prepare a Internet based report on IoT innovative applications.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I)   **Suggested Specification Table (For ESA of Classroom Instruction):**

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	Over View of IoT	4	4	4	12
II	IOT Devices and Wed Connectivity	4	7	7	18
III	Sensors and other Hardware's for IoT	4	6	6	16
IV	Interfacing sensors and IoT devices	4	5	5	14
V	IoT Applications	2	4	4	10
Total		**18**	**26**	**26**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J)   **Suggested Specification Table (For ESA of Laboratory Instruction*):**

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Identify the different sections of IoT Kit.	15	10	05
LE1.2	Differentiate between IoT and M2M connections.	15	10	05
LE2.1	Establish Bluetooth channel for data transfer,	15	10	05
LE2.2	Establish channel to transfer data on Wi-Fi network.	15	10	05
LE2.3	Establish connection to transfer data on the GSM network.	15	10	05
LE3.1	Identify and test the power module of IoT system.	15	10	05
LE3.2	Identify and test the sensor module of IoT system.	15	10	05
LE3.3	Identify and test the RF module of IoT system.	15	10	05
LE3.4	Test the performance of the given type of sensor.	15	10	05
LE4.1	Interface sensors with Arduino for data collection.	15	10	05
LE4.2	Interface sensors with Raspberry -Pi for data collection.	15	10	05
LE4.3	Develop simple IoT smart home system with the help of Arduino and relay banks.	15	10	05
LE5.1	Develop simple home appliances switch control system.	15	10	05
LE5.2	Develop simple street light control system based on IoT architecture.	15	10	05
LE5.3	Describe the complete design of a parking place display system.	15	10	05

* Assessment rubric, process and product check list   with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend: PRA: Process Assessment, PDA: Product Assessment

Note: Only one experiment has to performed at the end semester examination of 30 Marks as per assessment scheme

K)   **Suggested Instructional/Implementation Strategies:**
   1.   Improved Lecture
   2.   Tutorial
   3.   Case Method

4.   Group Discussion
5.   Industrial visits
6.   Industrial Training
7.   Field Trips
8.   Portfolio Based Learning
9.   Role Play
10.   Demonstration
11.   ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12.   Brainstorming
13.   Others

L)   Suggested Learning Resources:

(a)   Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Internet of Things: A Hands-on Approach	ArshdeepBahga and Vijay Madisetti	Universities Press, , New Delhi, ISBN: 9788173719547	2015 or Latest edition
2	Internet of Things	Dr.Jeeva Jose	Khanna Publishing House, , New Delhi	Edition 2017, Latest edition
3	Internet of Things: Architecture Design andPrinciples	Raj Kamal	Tata McGraw Hill, HED, New Delhi, ISBN: 9789352605224, 9352605225	Edition 2017 or Latest edition
4	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases"	Pethuru Raj and Anupama C. Raman	CRC Press, , New Delhi	Latest edition
5	Designing the Internet of Things	Adrian McEwen & Hakim Cassimality	Wiley India, ISBN: 9788126556861	Latest edition

(b)   Open source software and website address:

1.   https://simple.wikipedia.org/wiki/Internet_of_things
2.   https://www.guru99.com/live-insurance-testing-project.html
3.   https://www.tutorialspoint.com/internet_of_things/internet_of_things_useful_resources.htm
4.   https://en.wikipedia.org/wiki/Internet_of_things
5.   https://www.raspberrypi.org/blog/getting-started-with-iot/
6.   https://www.arduino.cc/en/IoT/HomePage
7.   https://www.microchip.com/design-centers/internet-of-things
8.   https://learn.adafruit.com/category/internet-of-things-iot
9.   http://esp32.net/
10.   https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22

M)   List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Digital Multimeter	3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc}(1000V max) , A_{dc}, A_{ac} (10 amp max) , Resistance (0 - 100 MΩ) , Capacitancemeasurement, component tester)with working manual	LE3.1, LE3.2, LE3.3, LE3.4

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
2	Arduino Board, IntelGalileo, Raspberry Pi-2/ Pi-3 kits	As per nitiayog specification	LE4.1, LE4.3,LE4.2, LE5.1,LE5.2,LE5.3
3	Wi-fi module, GSM Module, Bluetooth module	Compatible with the IoT kit and as per latest spect. Available, As per nitiayog specification	LE2.2
4	Sensor Kit	21 different common type of sensors or As per nitiayog specification, sensors, which take in data about the world around them; and actors, which get things done. The lineup is similar to other Internet of Things development kits aimed at less technically inclined users like littlebits, and includes buttons, sliders, and switches; pressure, light, motion, and temperature sensors; and lights, motors, and servos.	LE3.2
5	IoT development kit	Tri-band UMTS/HSDPA 2100/1900/850 MHz - Quad-band GSM 850/900/1800/1900 MHz - Standalone GPS, 2.4GHz WiFi b/g/n *Sensors*: Accelerometer, Light, Temperature, humidity and other common sensors *Cloud*: Integration of Device Cloud by Etherios or latest configuration and extention	LE3.1,LE3.2, LE3.3

N)   Mapping of POs & PSOs with COs:

Course Outcomes (COs)		Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
		PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1	Interpret the functions of basic building blocks of Internet of Things (IoT) systems.	2	3	3	2	1	1	1	1	1	1	2	2
CO-2	Interpret different types of protocol and communication technology used in IoT system.	2	3	3	3	1	1	1	1	1	1	3	3
CO-3	Identify the basic hardware requirement of IoT system.	2	3	3	2	1	1	1	1	1	1	3	2
CO-4	Interface sensors with IoT devices.	2	3	3	3	1	1	1	1	1	1	3	3
CO-5	Summarize the different application areas of IoT.	2	2	2	2	1	1	1	1	1	1	3	3

Legend:1 – Low, 2 – Medium, 3 – High

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Electronics and Telecommunication Engineering **Semester -VI**

O)   **Course Curriculum Map:**

POs & PSOs No.	COs No.& Titles		SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1	Interpret the functions of basic building blocks of Internet of Things (IoT) systems.	SO1.1, SO1.2 SO1.3, SO1.4	LE1.1, LE1.2	Unit 1.0 Overview of IoT 1.1,1.2, 1.3,1.4,1.5,1.6	As mentioned in relevant page number
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2	Interpret different types of protocol and communication technology used in IoT system.	SO2.1, SO2.2 SO2.3, So2.4	LE2.1, LE2.2 LE2.3	Unit 2.0 IOT Device and Web Connectivity 2.1,2.2,2.3,2.4,2.5,2.6	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3	Identify the basic hardware requirement of IoT system.	SO.3.1 SO3.2 SO3.3	LE3.1, LE 3.2, LE3.3, LE3.4	Unit 3.0 Sensors and other Hardware's for IoT 3.1, 3.2, 3.3, 3.4, 3.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4	Interface sensors with IoT devices.	SO4.1, SO4.2, SO4.3, SO4.4	LE4.1, LE4.2, LE4.3	Unit 4.0 Interfacing sensors and IoT devices 4.4, 4.2, 4.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5	Summarize the different application areas of IoT.	SO5.1,SO5.2 SO5.3, SO5.4, SO5.5	LE5.1 LE5.2 LE5.3	Unit 5.0 IoT Applications 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A)	Course Code	:	**2028663(028)**
B)	Course Title	:	**Electronics Simulation**
C)	Pre-requisite Course Code and Title	:	**Electronics Devices and Circuits, Electronic Workshop, Analog Circuits-I and II, Digital Electronics, Communication-I**
D)	Rationale	:	

Electronics Design and Automation (EDA) tools empower the designers to simulate and test any electronics circuits before its physical implementation. Simulation and testing of any electronic circuit on EDA tools provides extra facilities to select and use the range of components and test the circuit for the range of input to analyze the circuit performance. It reduces the manufacturing error and cost, optimize the circuit performance. In the present industrial scenario, trained manpower is in huge demand to work on the different EDA tool, interpret, analyze and edit the design as per the required output.

E) Course Outcomes:

CO-1   **Install an EDA tool and test the simple electronic circuit.**

CO-2   **Use EDA tool to simulate the given analog electronic circuit.**

CO-3   **Use EDA tool to simulate the given digital electronic circuit.**

CO-4   **Use EDA tool to develop single/double layer PCB layout.**

CO-5   **Develop communication related circuits and test using specified EDA tool.**

F) Scheme of Studies:

S.No	Board of Study	Course Code	Course Title	L	P	T	Total credit L+T+P/2
				Scheme of Studies (Hours/Week)			
1	E&TC Engineering	2028663(028)	Electronics Simulation (Lab)	-	4	-	2

Legend: L - Lecture   T - Tutorial   P - Practical

G) Scheme of Assessment:

S. No	Board of Study	Course code	Course Title	ESE	CT	TA	ESE	TA	Total Marks
				Theory			Practical		
1	E&TC Engineering	2028663 (028)	Electronics Simulation (Lab)	-	-	-	30	50	120

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.
Convert unit of the given physical quantity from one unit system to other.

CO-1   Install an EDA tool and test the simple electronic circuit.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Describe the installation procedure of the given EDA tool. SO1.2 Describe the procedure to test the given circuit using the given EDA tool.	LE1.1 Open the new EDA file/project and save at the given place. LE1.2 Copy the available code/file and make the changes in the circuit by changing component values. LE1.3 Connect one or more source and discrete components and complete the circuit in the circuit window. LE1.4 Connect the resistors in series and parallel combination and measure the current and voltages in the circuit using EDA tool. LE1.5 Perform node and loop analysis of the given resistive network containing three voltage sources.	**Unit-1.0Introduction to EDA tool** 1.1 Hardware and software requirements to install the specified free/ Licensed Electronic Design Automation (EDA)tool 1.2 Introduction to: SCILAB, esim, spice, LABVIEW, Proteus, Orcad, Multisim, TINA,MATLAB, or any other licensed or open source software, 1.3 Open the basic interface of the Electronic Design Automation tool(EDA) and explore the various tabs and functions 1.4 Open demo files, help files and new project/file/code and explore it 1.5 Explore the following operations: file, Edit, save, open, run, test, simulate, export and import. 1.6 Connect sources, test, and measuring instruments with analog and digital components and complete the circuit	• Describe main features of the given EDA tool. • Use different free EDA tools to simulate and test the given electronic/electric circuit.

SW-1   Suggested Sessional Work (SW):
    a. Assignments:
        i.   Describe advantages of the given EDA tool for circuit design.
        ii.   List functions of the given EDA tools.
    b. Mini Project:
        i.   Prepare a presentation to demonstrate the use of any one free EDA tools.
    c. Other Activities (Specify):
        i.   Prepare a chart to compare the features of any three free EDA tool.
        ii.   Prepare a chart to represent the steps to simulate and test the given electronic circuit using any free EDA tool.

CO-2   Use EDA tool to simulate the given analog electronic circuit.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Explain the need for the virtual and real component. SO2.2 Describer the rules of component selection for the design of any	LE2.1 Simulate and test the integrator circuit. LE2.2 Simulate and test the differentiator circuit. LE2.3 Simulate and test the clipper and clamper circuit.	**Unit-2.0 Analog Circuit Simulation** 2.1 Use Basic Components: Resistor, capacitor, inductor, diodes, transistors, FETS, power diodes and transistors, relays, switches	• Describe the working of the demo/example circuits available in the help folder. • Summarize the

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
circuit.	LE2.4 Simulate and test the comparator circuit for two DC input signal. LE2.5 Simulate and test the half wave and full wave rectifier. LE2.6 Simulate and test the astablemultivibrator circuit contain the timer IC. LE2.7 Simulate and test the bistablemultivibrator circuit contain the timer IC. LE2.8 Simulate and test voltage regulator circuit contains IC 7810.	2.2 Use Power sources, AC, DC, battery, ground, virtual ground, current and voltage sources 2.3 Use Miscellaneous components and ICs:- buzzer, lamps, LEDs, probes, OPAMP IC, Timer IC, voltage regulator IC	database available with the specified EDA tool.

SW-2   Suggested Sessional Work (SW):

a. **Assignments:**
   i.   Simulate a clamper circuit, which clamps the given sinusoidal input to 10 volt above the zero level.
   ii.   Simulate a timer circuit to generate a waveform of 10 miles second time period.
b. **Mini Project:**
   i.   Develop a low pass filter and carry out the transient analysis of the same using EDA tool.
   ii.   Carry out the DC analysis of the common emitter and common base amplifier.
c. **Other Activities (Specify):**
   i.   Arrange group discussion on the topic "Use of EDA tools".

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

CO-3   Use EDA tool to simulate the given digital electronic circuit.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain the design rules for digital circuits. SO3.2 Describe the steps to test the functionality of digital circuits. SO3.3 Compare the characteristics of various types of digital inputs.	LE3.1 Test the functions of various logic gates. LE3.2 Test the functions of various FF. LE3.3 Simulate and test half adder circuit. LE3.4 Simulate and test full adder circuit. LE3.5 Simulate and test four-bit parallel adder circuit. LE3.6 Develop a 4-bit parity generator circuit. LE3.7 Simulate a Mod-10 up counter. LE3.8 Test the functions of the given type of shift	**Unit 3.0 Digital Circuit Simulation** 3.1 Fonctions of Logic of Gates : AND, OR, NOR, NAND, XOR,XNOR,NOT 3.2 TestingFilp-Flop(FF) :- RS,JK, D,T, Master slave, synchronization, latch and FF operation 3.3 Truth table verification, digital circuit design based on truth table, simplification of	• Compare different types of gates ICs specifications. • Calculate the delay produced by the various counters used in digital clock circuit.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
	register.	Boolean equations 3.4 Testing of following circuits : Adder, Subtractor, Multiplier, Coder and Decoder, Multiplexer and de-multiplexers, Counters, Clocks, Shift register	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-3   Suggested Sessional Work (SW):

   a. **Assignments:**
      i.   Compare the functions of FF and gates.
      ii.   Develop a tree for 1 to8, 1to16, 1 to 32-line de-multiplexer.
   b. **Mini Project:**
      i.   Develop a sequence/event counter circuit.
      ii.   Simulate a circuit contains of LCD display and other discrete components.
   c. **Other Activities (Specify):**
      i.   Seminar on simple digital circuits used for various applications.

   Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

CO-4   Use EDA tool to develop single/double layer PCB layout.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 List advantages of use of PCB for the circuit implementation. SO4.2 Compare different types of PCB used to develop an electronics circuit. SO4.3 Describe the general PCB design rules.	LE4.1 Develop a PCB layout for the given simple application circuit. LE4.2 Develop a single layer PCB layout of the voltage regulator circuit. LE4.3 Develop a PCB layout of the given digital electronics based circuit. LE4.4 Develop a double layer PCB layout of the given circuit.	**Unit 4.0 PCB designing** 4.1 Advantages of use of PCB for the development of application circuit 4.2 Types of PCB, size, material 4.3 General design rules of PCB, rules for tracks, components, packages, components padding, IPC standards 4.4 Steps in PCB development, PCB design flow chart. 4.5 Trends in PCB design	• List the types of packages available for the analog and digital ICs. • Explain the general guideline rules for the component padding.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-4   Suggested Sessional Work (SW):

a. **Assignments:**
    i.   Develop a PCB layout for the LED blinking circuit consists of IC555 and other discrete components.
    ii. Develop a dual sided PCD layout for the audio amplifier circuit.
b. **Mini Project:**
    i.   Develop a PCB layout for the digital clock circuit.
    ii. Develop a PCB layout for the home automation circuit consists of 5 relay and other discrete components.
c. **Other Activities (Specify):**
    i.   Seminar on the PCB design trends.

CO-5   Develop communication related circuits and test using specified EDA tool.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Describe the limitations of RF components in the EDA tools. SO5.2 Describe the procedure to test the RF circuits using EDA tool.	LE5.1 Test the performance of TUNNEL diode. LE5.2 Test the performance of Schottkey Diode. LE5.3 Develop the Amplitude modulated circuit and test the performance for the various modulating signals. LE5.4 Simulate PWM circuit and observe the out for the different input modulating signals.	**Unit 5.0 Basic Communication Circuit simulation** 5.1 Explore the example communication circuits available in the specified EDA tool. 5.2 Explore the functions of the communication and RF components available in the EDA tool data base	• List the RF component available in the specified EDA tool. • Describe the frequency limitation and working range of RF components.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5   Suggested Sessional Work (SW):

a. **Assignments:**
    i.   Differentiate between RF and simple MOS transistor frequency characteristics using EDA tool compnnent database.

b. **Mini Project:**
    i.   Simulate and test Frequency modulated circuit using any EDA tool.
    ii. Simulate and test the High pass and low pass filters used in RF communication.

c. **Other Activities (Specify):**
    i.   Seminar on applications of EDA tool for RF circuit simulation and testing.

I)   Suggested Specification Table (For ESA of Classroom Instruction):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

-	-	-	-	-	-
-	-	-	-	-	-
	-	-	-	-	-

J)   **Suggested Specification Table (For ESA of Laboratory Instruction*):**

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Open the new EDA file/project and save at the given place.	15	10	5
LE1.2	Copy the available code/file and make the changes in the circuit by changing component values.	15	10	5
LE1.3	Connect one or more source and discrete components and complete the circuit in the circuit window.	15	10	5
LE1.4	Connect the resistors in series and parallel combination and measure the current and voltages in the circuit using EDA tool.	15	10	5
LE1.5	Perform node and loop analysis of the given resistive network containing three voltage sources.	15	10	5
LE2.1	Simulate and test the integrator circuit.	15	10	5
LE2.2	Simulate and test the differentiator circuit.	15	10	5
LE2.3	Simulate and test the clipper and clamper circuit.	15	10	5
LE2.4	Simulate and test the comparator circuit for two DC input signal.	15	10	5
LE2.5	Simulate and test the half wave and full wave rectifier.	15	10	5
LE2.6	Simulate and test the astablemultivibrator circuit contain the timer IC.	15	10	5
LE2.7	Simulate and test the bistablemultivibrator circuit contain the timer IC.	15	10	5
LE2.8	Simulate and test voltage regulator circuit contains IC 7810.	15	10	5
LE3.1	Test the functions of various logic gates.	15	10	5
LE3.2	Test the functions of various FF.	15	10	5
LE3.3	Simulate and test Half adder circuit.	15	10	5
LE3.4	Simulate and test full adder circuit.	15	10	5
LE3.5	Simulate and test four-bit parallel adder circuit.	15	10	5
LE3.6	Develop a 4-bit parity generator circuit.	15	10	5
LE3.7	Simulate a Mod-10 up counter.	15	10	5
LE3.8	Test the functions of the given type of shift register.	15	10	5
LE4.1	Develop a PCB layout for the given simple application circuit.	15	10	5
LE4.2	Develop a single layer PCB layout of the voltage regulator circuit.	15	10	5
LE4.3	Develop a PCB layout of the given digital electronics based circuit.	15	10	5
LE4.4	Develop a double layer PCB layout of the given circuit.	15	10	5
LE5.1	Test the performance of TUNNEL diode	15	10	5
LE5.2	Test the performance of SchottkeyDiode.	15	10	5
LE5.3	Develop the Amplitude modulated circuit and test the performance for the various modulating signals.	15	10	5

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE5.4	Simulate PWM circuit and observe the out for the different input modulating signals.	15	10	5

*Assessment rubric, process and product check list   with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practical's.
Legend: PRA: Process Assessment, PDA: Product Assessment
Note: Only one experiment has to be performed at the end semester examination of **30**Marks as per assessment scheme.

K)   Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L)   Suggested Learning Resources:

(a)   Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Printed Circuit Boards: Design and Technology	Walter C. Bosshart	McGraw-Hill Education, New Delhi	1983, First edition , ISBN0074515497 and 9780074515495
2	Complete PCB Design Using OrCAD Capture and PCB Editor	KraigMitzner	Newnes Pap/Cdr, India	28 May 2009, **ISBN-13:** 978-0750689717
3	Network Analysis and Synthesis	Ghosh, S.P.; Chakrabarti, A.K.	McGraw-Hill Education, New Delhi	2010 edition, ISBN: 9780070144781
4	Electronics Devices and Circuit Theory	Boylestad, Robert L.	Pearson Education Publication, New Delhi, 03	2015 edition, ISBN: 97881317270

(b)   Open source software and website address:

1.   https://en.wikipedia.org/wiki/Electronic_design_automation
2.   https://www.oreilly.com/library/view/...design/.../0131828290_ch01lev1sec3.html
3.   Open sourse EDA tool for circuit simulation:- www.esim.fossee.in
4.   Tutorial for e-sim software :- esim.wikia.com/wiki/Tutorial_the_basics_of_e-sim
5.   Scilab software:- www.scilab.org/download/latest
         d. Scilab tutorial:-www.scilab.org/resources/documentation/tutorial
6.   Tina software official website:- https://www.tina.com
7.   Tina software tutorial:-https://www.tina.com/tutorials
8.   LT spice software:-http://www.linear.com/designtools/software/#LTspice

9. Open source hard ware project:- http://www.electronics-lab.com/downloads/circutedesignsimulation/?page=5 /
10. Circuitlogix software :-https://www.circuitlogix.com/student_version.ph
11. Spectrum soft ware:- www.spectrum-soft.com/
12. Free e-book:-www.talkingelectronics.com/projects/...1A/BasicElectronics-1A_Page1.html

M)   List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1.	Desk top computers	Processor: Intel Core i7-2600 Processor, 3.4GHz, 8M Cache Operating system: Windows 7 Professional 64 - English, with latest service pack System Recovery DVD: Genuine Windows 7 Professional 64 - Recovery DVD , Video adapter, Integrated Video Intel Audio adapter: & Burner Software) , Pointing device: Optical Mouse with Scroll Button, Speakers: Internal speaker Power cord: Line Cord –Monitor: 22 inches wide LCD monitor with Install-Ready Security Cable Lock Hole Feature Security	All
2.	Laser printer	Print Speed: 33 ppm mono (A4) and above , Monochrome laser beam printing,Print Quality. Up to **1200** x **1200** dpi, Print Resolution. **600** x **600** dpi, Warm-up Time. Approx. 28 seconds or less from power on. Print Margins. 5 mm-top, bottom, left and right.	All
3.	Modem/Wifi- modem	450Mbps and above wireless speed ideal for interruption sensitive applications like HD video streaming, Three antennas increase the wireless robustness and stability, Easy wireless security encryption at a push of WPS butto,IP based bandwidth control allows administrators to determine how much bandwidth is allotted to each PC	All
4.	Internet connection	Broad band	All
5.	EDA tools like:	eSim/ LTSPICE /TINA/OrCAD/ MultiSim/SPICE/ /Easy EDA /Circuit Logix/ MicroCap /SciLAB	All
6.	Projector and screen	Full HD resolution, White and colour light output at 2,500 lumens, Contrast ratio at 1,000,000:1, 4K enhancement technology, Ease of setup with motorised lens adjustment	All

N) **Mapping of POs & PSOs with COs:**

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Install an EDA tool and test the simple electronic circuit.	2	2	3	3	1	2	2	3	2	3	3	3
CO-2 Use EDA tool to simulate the given analog electronic circuit.	1	3	3	3	1	1	1	3	2	3	3	3
CO-3 Use EDA tool to simulate the given digital electronic circuit.	1	3	3	3	1	1	1	3	2	3	3	3
CO-4 Use EDA tool to develop single/double layer PCB layout.	1	3	3	3	1	1	1	3	2	3	3	3
CO-5 Develop communication related circuits and test using specified EDA tool.	1	3	3	3	1	1	1	3	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

O)　　Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1 Install an EDA tool and test the simple electronic circuit.	SO1.1 SO1.2	LE1.1, LE1.2 LE1.3, LE1.4 LE1.5	Unit 1.0 Introduction to EDA tool 1.1, 1.2, 1.3,1.4, 1.5,1.6	As mentioned in relevant page number
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2 Use EDA tool to simulate the given analog electronic circuit.	SO2.1 SO2.2	LE 2.1, LE 2.2, LE 2.3, LE2.4, LE 2.5, LE 2.6 LE 2.7, LE2.8	Unit 2.0 Analog Circuit Simulation 2.1, 2.2, 2.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3 Use EDA tool to simulate the given digital electronic circuit.	SO3.1 SO3.2 SO3.3	LE 3.1, LE 3.2, LE 3.3, LE3.4, LE 3.5, LE 3.6 LE 3.7, LE3.8	Unit 3.0 Digital Circuit Simulation 3.1, 3.2, 3.3, 3.4	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4 Use EDA tool to develop single/double layer PCB layout.	SO4.1 SO4.2 SO4.3	LE4.1, LE4.2, LE4.3, LE4.4	Unit 4.0 PCB designing 4.1, 4.2, 4.3,4.4, 4.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5 Develop communication related circuits and test using specified EDA tool.	SO5.1 SO5.2	LE5.1, LE5.2, LE5.3, LE5.4	Unit 5.0 Basic Communication Circuit simulation 5.1, 5.2	

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A)	**Course Code**	:	**2028664(028)**
B)	**Course Title**	:	**Major Project**
C)	**Pre- requisite Course Code and Title**	:	
D)	**Rationale**	:	

Project work plays a very important role in engineering educations in developing core technical skills, soft skills and higher level of cognitive, psychomotor and affective domain skills. It encourages the thinking process in the students.

Project work is normally done when students have acquired sufficient knowledge, skills and attitude and are able to integrate all these, entirely in new situation or task to solve the problems of the industries.

Through project work, students get direct exposure to the world of work in their relevant field. They are intrinsically motivated to explore new things, new methods, new design and many more ideas.

They also develop many soft skills like confidence, communication skills, creative ability, inquisitiveness, learning to learn skills, lifelong learning skills, problem solving skills, management skills, positive attitude, ethics etc. through project work.

Normally in a curriculum document, there is a mention of project work in two different situations.
In situation one, Project work is reflected as Mini Project under each and every course curricular detailing, in the form of sessional work mentioned under different semesters. These projects are normally related to the developing skills in respective course of the specific programme.

In another situation, project work is reflected as a complete course or as a major project in the total programme structure, normally at higher semester either at 4th, 5th and 6th, depending on the requirement of the programme. Normally.

E)   **Course Outcomes:** After completion of the project work of a course or full semester, the students will be able to -

CO-1   **Integrate the Knowledge (K), Skills (S), Attitudes (A) developed in a new task or problem identified in the form of project work.**

CO-2   **Develop higher level of cognitive, psychomotor and affective domain skills relevant to the course/programme.**

CO-3   **Integrate the generic skills/soft skills/employable skills with relevant technical skills for successful completion of the project work.**

CO-4   **Develop the skills of innovativeness, creativity, resourcefulness, time management, problem solving abilities, interpersonal skills, pro-activeness, cost effectiveness, environment consideration and sustainability.**

F)   **Scheme of Studies:**

S.No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total credit L+T+P/2
1	E&TC Engineering	2028664 (028)	Major Project	-	4	-	2

Legend: L - Lecture   T - Tutorial   P - Practical

G) **Scheme of Assessment:**

S.No	Board of Study	Course Code	Course Title	Schemes of Examination					Total Marks
				Theory			Practical		
				ESE	CT	TA	ESE	TA	
1	E&TC Engineering	2028664 (028)	Major Project	-	-	-	80	80	160

Legend: ESE - End semester exam   CT - Class Test   TA - Teachers Assessment

H) **Guidelines to Teachers for Implementation of the Project Work :**

Once the project is identified and allocated to students, teacher's role is very important. Teachers act as guide, facilitator, catalyser, motivator to promote brain storming, thinking, creatively, initiativeness and many other skills in the students. Teachers should help or guide continually to monitor whether the students are proceeding in the right direction as per outcomes to be attained.

It is also suggested that teachers are not supposed to guide and plan each and every step from the point of view of execution of the project, otherwise it will curb their creativity or thinking process. Teachers have to see that he or she is able to create think tank for this fast technological world of work for the growth of our country. Following points should be taken into consideration while planning and implementing the project work.

1.   **Identification of project and allocation methodology :**

Though the teachers and students, both are involved in identification of project titles, but the prime responsibility of identification of project titles goes to the teachers involved in implementing the course or programme. Teachers are fully aware of course/programme curriculum. They are also aware of related industrial problems. They try to explore the possibility of identification of project titles through these problems.

These small industrial problems in the form of project titles may be brought into the laboratories or workshop of institutions of a specific programme, which are equipped with all necessary facilities and resources to carry out the project work. These labs or workshop can function as miniature industry to solve the industrial problems in the form of simulated industrial projects. These projects may be integrated problem of courses or programme.

The project identified may beapplication type, product type, Research type and review type.

   1.1 Criteria for Identification and Implementation of Project Titles :

Identification of project title is planned to be done based on many considerations like :
- Cost effectiveness
- Safety considerations
- Ethical issues
- Environmental considerations
- Improvised process
- Improvised equipment
- Simulated industry's problem
- Application or utility in the world of work.
- Relevance to the Curriculum
- Mapping of Outcomes of Project with POs and PSOs
- Feasibility of implementation of the project

2.   **Implementation and Evaluation of Project Work:**

Once the identification of project titles and guide allocation process is over, quality of student's project, on different criteria including the report writing need to be continually monitored.

Projects planning, design, execution and report writing is done by the students under the guidance and feedback by respective teachers for attainment of courses specific outcomes, POs and PSOs.

Continual Monitoring, feedback and assessment mechanism on weekly progress/updates on action taken on different criteria and sub-criteria of the project work need to be planned for individual and team of students. Path breaking teachers who think out of the box are required to guide, monitor and evaluate the project work.

For objective, valid and reliable assessment, teachers should use different tools of assessment such as checklist, rating scale, assessment rubric, observation schedule, portfolio assessment, incidental records etc. Even the students may be encouraged to adopt self assessment techniques using the assessment rubrics.

2.1 Criteria of Evaluation of Project:

The different criteria of evaluation of project under different sub heads of project work completion are given below :

2.2.1 Project Planning :

Project planning, its action plan, steps of realizing the projects, may be specifically planned in advance based on feasibility, resources available, time allocation, finance and manpower requirement for each and every step or activity of project work.

Under project planning, many points need to be considered like -

- Selection of relevant industry based projects as per the requirement of curriculum
- Rationale/Application
- Objectives Set
- Literature survey
  Literature survey on the project title need to be done through abstract, journals, websites, open sources and other relevant sources available.
  It need to be ensured that objectives are written properly with clear specific, measurable and attainable statements. The sample size has to be delimited and decided as per the time limit allotted, feasibility and many other considerations.
  Objectives formulated will decide the further course of action, depth and breadth of the project and implementation plan.

2.2.2 Design, Development and Execution of Project :
Following important characteristic features of project are need to be given special emphasis during the implementation of the project work-
- Innovativeness
- Creativity
- Originality
- Pro-activeness
- Initiativeness
- Cost Effectiveness
- Resourcefulness
- Development of soft skills/generic skills

There may be deviation from planning, design and implementation of the project as per the requirement.

2.2.3 Quality of Report Writing :
Following points need to be taken care of for report writing-

- Report writing as per prescribed format
- Clarity of Objectives
- Presentation of Data
- Data Analysis, Interpretation and Result
- Quality of Product

2.2.4 Presentation & Discussion :

Quality of presentation of data need to be ensured using the following criteria -

- Clarity in Communication and Presentation
- Voice Audibility
- Use of Media and methods
- Satisfying the queries of audience
- Attainment of objectives set

2.2.5 Project's Potential :

Futuristic scope and recommendation for further studies related to project may be assessed from the following criteria -

- Papers published or award received
- Exhibition or Display or showcase of project in competition or exhibition or Tech Fest
- Evaluation of working of projects or prototype
- Relevance and Applications in the world of work
- Recognition in any form
- Related areas/sub areas for further studies

The students need to be assessed continuously based on the assessment rubric prepared by the implementing teachers on different stages of project work completion.