ANNEXURE-45

Department of Electronics and Communication Engineering
Bhagat Phool Singh Mahila Vishwavidyalaya,
Khanpur Kalan (Sonepat), Haryana-131305
(A state university established by govt. of Haryana vides Act no. 31 of 2006)
www.bpswomenuniversity.ac.in

Course Structure for B. Tech Fifth Semester (Third Year)

Sl. No	Code	Course Title	Hrs/Week L	T	P	Total Credits	Internal Marks	External Marks	Total Marks
Subjects									
1.	ECL-351	Linear Integrated Circuits	3	0	0	3	20	80	100
2.	ECL-353	Digital Signal Processing	3	0	0	3	20	80	100
3.	ECL-355	Microwave Theory and Techniques	3	0	0	3	20	80	100
4.	ECL-357	Electromagnetic Waves & Propagation	3	0	0	3	20	80	100
5.	*	Program Elective-I	3	0	0	3	20	80	100
6.	**	Open Elective-I	3	0	0	3	20	80	100
7.	HSMC-351	#Foreign Language	3	0	0	0	10	40	50#
Labs									
8.	ECP-351	Linear Integrated Circuits Lab	0	0	2	1	10	40	50
9.	ECP-353	Digital Signal Processing Lab	0	0	2	1	10	40	50
10.	ECP-357	Community Service Oriented Project	0	0	2	1	10	40	50
11.	IPT-359	Professional Training Assessment– I	0	0	0	1	50	0	50
12.	HSMC-351	#Non Verbal Reasoning/ Generic Open Elective	2	0	0	0	50	0	50#
Total			23	0	6	22	200	600	800

*PROGRAM ELECTIVE-I	
Code	Subject
ECEL-351	Wireless and Mobile Communication
ECEL-353	Analog CMOS Design
ECEL-355	Information Theory and Coding
ECEL-357	Internet of Things
******	MOOC / NPTEL Course

** OPEN ELECTIVE-I	
Code	Subject
OEL-351	Optimization Techniques and Application
OEL-353	Cyber Law and Security
OEL-355	Marketing Management and HRM
OEL-357	Remote Sensing & GIS
******	MOOC / NPTEL Course

Note: 1. #Foreign Language (BSC-351) & Non Verbal Reasoning/ Generic Open Elective (HSC-351) shall be non credit, mandatory and qualifying paper. The marks of the same will not be counted in grand total and towards award of degree.
2. Students may opt Generic Open Elective course from CBCS offered by other department.
3. All Professional Training will be done in the summer break in the previous year and the assessment for the same will be done in the first four weeks of the opening of the academic session by the department in the next semester.
4. Students may opt NSS/NCC as per their choice for community service towards social responsibility.

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Course Structure for B. Tech Sixth Semester (Third Year)									
S. No.	Code	Course Title	Hrs/Week			Total Credits	Internal Marks	External Marks	Total Marks
			L	T	P				
Subjects									
1.	ECL-360	Mobile Communication and Network	3	0	0	3	20	80	100
2.	ECL-362	Control Systems	3	0	0	3	20	80	100
3.	ECL-364	Single Board Computers for Electronic System Design	3	0	0	3	20	80	100
4.	ECL-366	Digital System Design	3	0	0	3	20	80	100
5.	*	Program Elective-II	3	0	0	3	20	80	100
6.	**	Open Elective-II	3	0	0	3	20	80	100
7.	#HSMC-360	#Essence of Indian Traditional Knowledge	3	0	0	0	20	80	100#
Labs									
8.	ECP-360	Computer Networks Lab	0	0	2	1	10	40	50
9.	ECP-362	Electronic Measurement Lab	0	0	2	1	10	40	50
10.	ECP-364	Single Board Computers for Electronic System Design Lab	0	0	2	1	10	40	50
11.	ECP-366	Scriptive Language Lab	0	0	2	1	10	40	50
Total			21	0	8	22	160	640	800

*Program Elective-2	
Subject Code	Subject
ECEL-360	Satellite Communication
ECEL-362	Telecommunication Switching Systems and Networks
ECEL-364	Wireless Sensor Network
ECEL-366	Scientific Computing

** Open Elective-2	
Subject Code	Subject
OEL-360	Scriptive Language
OEL-362	Electronic Measurement & Instrumentation
OEL-364	Waste to Energy
******	MOOCs / NPTEL Course

Note:
1. #Essence of Indian Traditional Knowledge (HSL-366) will be non credit, mandatory and qualifying course. The marks of the same will not be counted in grand total and towards award of degree.
2. At the end of semester every student has to undergo 4-6 weeks Professional training/ Internship. The assessment and viva-voce for the same will be conducted in next semester.
3. Students may opt Programme Elective/Open Elective/Generic elective course from CBCS offered by other department.

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Course Structure for B. Tech Seventh Semester (Fourth Year)									
S No.	Code	Course Title	Hrs/Week L	T	P	Total Credits	Internal Marks	External Marks	Total Marks
Subjects									
1.	ECL-471	Fiber Optic Communications	3	0	0	3	20	80	100
2.	*	Program Elective-3	3	0	0	3	20	80	100
3.	**	Program Elective-4	3	0	0	3	20	80	100
4.	***	Program Elective-5	3	0	0	3	20	80	100
5.	****	Open Elective-3	3	0	0	3	20	80	100
Labs									
6.	ECP-471	Minor Project	0	0	8	4	20	80	100
7.	ECP-473	Design & Simulation Lab	0	0	2	1	10	40	50
7.	IPT-471	Professional Training Assessment–II	0	0	0	1	50	0	50
Total			**15**	**0**	**10**	**21**	**180**	**520**	**700**

*Program Elective-3	
Code	Subject
ECEL-471-A	Network Security and Cryptography
ECEL-471-B	Embedded System
ECEL-471-C	Digital Signal Processors and Architecture
ECEL-471-D	Machine Learning & AI
ECEL-471-E	Introduction to MEMS

***Program Elective-5	
Code	Subject
ECEL-475-A	Software Defined Radio
ECEL-475-B	VLSI Design
ECEL-475-C	Biomedical Signal Processing
ECEL-475-D	Advanced Mobile Communication
*******	MOOC/NPTEL Course

**Program Elective-4	
Code	Subject
ECEL-473-A	Multimedia Communication
ECEL-473-B	Consumer Electronics
ECEL-473-C	Digital Image & Video Processing
ECEL-473-D	Biomedical Instrumentation
ECEL-473-E	Mixed Signal Design

****Open Elective-3	
Code	Subject
OEL-471-A	Skills for Employability
OEL-471-B	Hybrid and Electrical Vehicle
OEL-471-C	Intelligent Instrumentation
OEL-471-D	Design Thinking & Product Innovation
OEL-471-E	Product Design & Simulation

Note:

1. Minimum passing marks for any subject (paper) shall be 40% in the external examination and 40% in the aggregate of internal and external examination of the subject

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2. Students may opt Elective course/Additional course as decided by Departmental Committee from NPTEL/MOOCs/Swayam or any other online platform. The course code for the same will be decided by Departmental Committee.
3. The students may opt individual project/R&D project/start-up project in collaboration with industry, R&D institutions etc.
4. Students may opt Programme Elective/Open Elective/Generic elective course from CBCS offered by other deptt.
5. Project coordinator and other assisting co-coordinators will be assigned the Project Stage-II load of, maximum of 02 hrs per week including their own guiding load of one hr. However, the guiding teacher will be assigned maximum of one period of teaching load irrespective of number of students/groups under him/her.

Internet of Things

ECEL-357
L T P
3 0 0

Total Credits: 3
Internal Marks: 20
External Marks: 80
Total Marks: 100

Course Objective: The students will be able to
1. Understand the basics of Internet of Things and protocols.
2. Learn application areas where Internet of Things can be applied.
3. Understand the middleware for Internet of Things.

Pre-requisite: None.

Course Outcomes: After completion of this course, student will be able to
1. Familiarize with the fundamentals of Internet of Things and protocols.
2. Identify suitable hardware and interfaces for IoT deployments.
3. Develop cloud computing model and service options.
4. Illustrate data analytics and security for IoT.

Content

UNIT- I	08 hrs
IoT Introduction and Fundamentals: Deciphering the term IoT Applications where IoT can be deployed Benefits/Challenges of deploying an IoT, IoT components: Digital Signal Processing, Data transmission, Choice of channel (wired/wireless), back-end data analysis. Understanding packaging and power constraints for IoT implementation. **Signals, Sensors, Actuators, Interfaces :** Introduction to sensors & transducers, Introduction to electrodes & biosensors, Static and dynamic characteristics of sensors, Different types of sensors, Selection criteria's for sensors / transducers, Signal conditioning modules of IoT system , Energy and power considerations, Introduction to actuators, Different types of actuators, Interfacing challenges, Modules of data acquisition system, Wireless sensor node structure, positioning topologies for IoT infrastructure.	
UNIT- II	**12 hrs**
Communication and Networking in IoT: Review of Communication Networks, Challenges in Networking of IoT Nodes, range, bandwidth. Machine-to-Machine (M2M) and IoT Technology Fundamentals, Medium Access Control (MAC) Protocols for M2M Communications Standards for the IoT Basics of 5G Cellular Networks and 5G IoT Communications, Low-Power Wide Area networks (LPWAN)Wireless communication for IoT: channel models, power budgets, data rates.Networking and communication aspects: IPv6, 6LoWPAN, COAP, MQTT, Operating Systems need and requirements for IoT.	
UNIT- III	**08 hrs**
Modern networking: Cloud computing: Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud, Hypervisors, Comparison of Cloud providers, Cloud and Fog Ecosystem for IoT Review of architecture	
UNIT- IV	**10 hrs**
IoT Data analytics and Security: OLAP and OLTP, NoSQL databases, Row and column Oriented databases, Introduction to Columnar DBMS CStore , Run :Length and Bit vector Encoding, IoT Data Analytics. Cryptographic algorithms, Analysis of Light weight Cryptographic solutions IoT security, Key exchange using Elliptical Curve Cryptography, Comparative analysis of Cryptographic Library for IoT. IoT Applications: IoT applications like Home Automation, Precision Agriculture, Smart vehicles,	

Smart Grid, Industry 5:0.	
Suggested Text Books/ References	
1.	A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", Universities Press (India) Pvt. Ltd. 2017.
2.	Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms"Copyright © 2016 Elsevier Inc.
3.	William Stallings, " Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" Publisher: Addison-Wesley 2015
4.	Samuel Greenguard, "Internet of things", MIT Press, 2015.
5.	http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of things1. html
6.	https://developer.mbed.org/handbook/AnalogIn
7.	http://www.libelium.com/50_sensor_applications/
8.	M2MLabs Mainspring http://www.m2mlabs.com/framework

Note: Nine questions will be set in all by the examiners taking two questions from each unit and one question containing short answer type questions from entire syllabus. Students will be required to attempt five questions, selecting one question from each unit. Question No.1 is compulsory which is from entire syllabus.

Mobile Communication and Network

ECL-360
L T P
3 0 0

Total Credits: 3
Internal Marks: 20
External Marks: 80
Total Marks: 100

Course Objective: The students will be able to
1. Understand the basics of Internet of Mobile Communication
2. Understand the concept of Mobile Communication and Networks.

Pre-requisite: None.

Course Outcomes: After completion of this course, student will be able to
1. Understand cellular concepts and signal propagation in mobile communication.
2. Perform small simulations and plot results on modulation techniques.
3. Analysis performance of different generations of mobile communications.
4. Solve numerical problems on different multi-access and modulation schemes of mobile communications.

Content

UNIT- I	08 Hours
Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G 3G, 4G and 5G cellular mobile standards.	
UNIT- II	**12 Hours**
Signal propagation- Propagation mechanism, reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels- Multipath and small-scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate. Capacity of flat and frequency selective channels. Antennas: antennas for mobile terminal, monopole antennas, PIFA, base station antennas and arrays.	
UNIT- III	**08 Hours**
Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM. Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity Altamonte scheme	
UNIT- IV	**10 Hours**
MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performance measures- Outage, average snr, average symbol/bit error rate. System examples GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA, 3G, 4G and 5G mobile communications. Smart Grid, Industry 5.0.	
Suggested Text Books/ References	
1.	Erik Dahlman , 4G: LTE-Advanced Pro and The Road to 5G
2.	Sassan Ahmadi, 5G NR: Architecture, Technology, Implementation, and Operation of

Advanced Mobile Communication

ECEL-475-D
L T P
3 0 0

Total Credits: 3
Internal Marks: 20
External Marks: 80
Total Marks: 100

Course Objective: The students will be able to understand the advanced mobile communications technologies, in particular the 5G Technology. As India and the world migrate to 5G, with India wishing to take a leading role in 5G technologies, trained manpower in these technologies will be necessary.

Pre-requisite: None.

Course Outcomes: After completion of this course, student will be able to
1. Analyze the performances of CDMA and OFDM.
2. Configure MIMO scheme for channel performance improvement.
3. Analyze the Error performance of Ultra Wide Band systems and applications to 5G Wireless Standards.

Content

UNIT- I	(11 hours)
Evolution from 1G to 5G- Analog voice systems in 1G; digital radio systems in 2G, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS), 2.75G (EDGE); IMT2000: 3G UMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates; IMT Advanced: 4G, LTE, VoLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+); IMT2020: 5G, enhancements in comparison to IMT Advanced..	
UNIT- II	**(11 hours)**
Basics of 5G- 5G potential and applications; Usage scenarios: enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D communications, V2X communications; Spectrum for 5G, spectrum access/sharing; millimetre Wave communication, channels, and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity..	
UNIT- III	**(14 hours)**
5G Network - New Radio (NR), Standalone and non-standalone mode; non-orthogonal multiple access (NOMA); massive MIMO, beam formation, FAPI: PHY API Specification, flexible frame structure, Service Data Adaptation Protocol (SDAP); centralized RAN, open RAN; multi-access edge computing (MEC); software defined networking (SDN), network function virtualization (NFV); network slicing; restful API for service-based interface; private networks.	
UNIT- IV	**(06 hours)**
Current state and Challenges ahead 5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements; large cell usage: LMLC; possible solutions for connectivity in rural areas (Bharat Net, TVWS, Long-range Wi-Fi, FSO); non-terrestrial front haul/backhaul solutions: LEOs, HAP/UAV.	
Suggested Text Books/ References	
1. 4G, LTE - Advanced Pro and The Road to 5G by Erik Dahlman.	

2.	5G NR - Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards Hardcover by Dr. Sassan Ahmadi, 1 June 2019.
3.	Jochen Schiller, Mobile Communications, Pearson, 2008
4.	Gordon L. Stuber, Principles of Mobile Communication , Springer,2017
5.	J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.

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