

RGPV (DIPLOMA WING)BHOPAL		OBECURRICULUMFOR THE COURSE		FORMAT-3	Sheet No. 1/5
Branch	Electronics & Tele-communication			Semester	6
Course Code		Course Name	Microwave and Radar Engineering		
Course Outcome1	Identify various microwave components.			Teach Hrs	Marks
Learning Outcome 1	Describe Microwave and various parameters related to it.			10	10
Contents	<p>Introduction to Microwave Microwave Frequency bands, Properties of microwave, General Applications of Microwaves, Advantages and limitations of Microwaves. Scattering parameters(S-parameters) Insertion loss, attenuation, VSWR, Return loss.</p>				
Method of Assessment	External Theory				
Learning Outcome 2	Illustrate microwave passive components.			10	10
Contents	<p>Microwave Passive components: Waveguide Microwave Junction: - H-Plane TEE, E-Plane TEE, Magic TEE with their S-parameters matrix and its applications (With simple numerical). - Rat Race Junction. - Directional Coupler with S parameter matrix for two port directional coupler (With simple numerical)..</p> <p>Power Divider, Corners, Bends, Twists, Attenuator, Resistive card, Ferrite rod, Twisted waveguide, Circulator and Isolators, and Resonator.</p>				
Method of Assessment	External Theory				
Learning Outcome 3	Verify the working of microwave passive components.			10	10
Contents	<p>Waveguide Microwave junction (E-PLANE TEE,H-PLANE TEE, Magic TEE) Directional coupler, Resistive card, Isolator etc.</p>				
Method of Assessment	External Practical				

RGPV (DIPLOMA WING)BHOPAL		OBECURRICULUMFOR THE COURSE		FORMAT-3		Sheet No. 1/5		
Branch		Electronics & Tele-communication			Semester		6	
Course Code		Course Name		Microwave and Radar Engineering				
Course Outcome 2		Classify different active microwave components.			Teach Hrs		Marks	
Learning Outcome4		Illustrate microwave solid state devices.			10		10	
Contents		Microwave Active components: Principle, working and application of: PIN diodes, Tunnel diode, Varactor diodes. Avalanche Transit Time devices: IMPATT Diode, TRAPATT diodes. Gunn Diodes: Principle, RWH Theory, Characteristics.						
Method of Assessment		External theory						
Learning Outcome 5		Verify the working of microwave solid state devices.			10		10	
Contents		Plot the characteristic of following solid state devices: Tunnel diode, PIN Diode, Varacter Diode, Gunn Diode etc.						
Method of Assessment		External Practical						

RGPV (DIPLOMA WING)BHOPAL		OBECURRICULUMFOR THE COURSE		FORMAT-3		Sheet No. 1/5		
Branch		Electronics & Tele-communication			Semester		6	
Course Code		Course Name		Microwave and Radar Engineering				
Course Outcome 3		Compare various microwave tubes and microwave measuring equipments.			Teach Hrs		Marks	
Learning Outcome6		Explain principle and working of microwave tubes.			10		10	
Contents		High Frequency limitations of Conventional tubes. Principle of operation, Schematic diagram, Performance characteristics and applications of Microwave Tubes: Two cavity Klystron Reflex Klystron Travelling wave Tube(TWT) Magnetrons: Structure of Cavity magnetron, Working principle, application.						
Method of Assessment		External Theory						
Learning Outcome 7		Demonstrate the working and evaluate different parameters for microwave tubes.			10		10	
Contents		Demonstrate the working of Microwave Tubes: Klystron Tubes TWT Magnetron						
Method of Assessment		Internal Practical						
Learning Outcome 8		Measure various parameters for microwaves.			10		10	
Contents		Demonstrate microwave measuring instruments : VSWR meter, Power meter, and Spectrum analyzer. Measurement of Frequency, Power, Losses and VSWR. Insertion loss, attenuation, Return loss.						
Method of Assessment		Internal Practical						
Learning Outcome9		Identify recent trends in microwave engineering.			10		10	
Contents		Working Principle of : - Microwave imaging. - Microwave oven.						

	Monolithic Microwave IC : Introduction, Selection of material as Substrate Materials, Conductor Materials, Dielectric Materials, Resistive Materials in monolithic microwave ICs. MMIC Fabrication Techniques-Thin and Thick Film IC technology, Hybrid ICs and their comparison.		
Method of Assessment	Internal Theory		
Learning Outcome 10	Relate environmental concerns in microwave engineering.	10	10
Contents	Microwaves Radiation and its effect on health. Introduction and standard(radiation hazards HERO,HERP,HERF)of Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC)		
Method of Assessment	Internal Theory		

RGPV (DIPLOMA WING)BHOPAL		OBECURRICULUMFOR THE COURSE		FORMAT-3	Sheet No. 2/5
Branch	Electronics & Tele-communication			Semester	6
Course Code		Course Name	Microwave and Radar Engineering		
Course Outcome 4	Categorize the working of different Radar.			Teach Hrs	Marks
Learning Outcome 11	Illustrate operation of RADAR.			10	10
Contents	Radar: Introduction, Block Diagram, Basic working Principle. Definition of Range, pulse width, PRF, duty cycle. Radar Frequencies, Millimeter and sub-millimeter waves. Application of Radar. Derivation of Radar Range Equation: Factors affecting Radar range, Prediction of Range Performance, Transmit power, Radar cross-section, Minimum Detectable Signal, Antenna gain. Simple numerical on Radar range equation.				
Method of Assessment	External Theory				
Learning Outcome 12	Define various scanning and Tracking Techniques.			10	10
Contents	Scanning Techniques: Horizontal scan Pattern, Elevation/Vertical scans Pattern, Spiral Scanning. Tracking Techniques: Mono-pulse tracking, Conical scan and Sequential lob switching, Low angle tracking. Working principle with functional block diagram of Pulsed Radar. Radar Display: A-scope and PPI Display.				
Method of Assessment	External Theory				
Learning Outcome 13	Compare different Doppler Radar.			10	10
Contents	Introduction to Doppler effect, concept of blind speed with numerical. Working principle with functional block diagram of: CW Radar. FM CW Radar. MTI Radar. Application and comparison of different Radars.				

Method of Assessment	External Theory		
Learning Outcome 14	Demonstrate working of RADAR system and measure parameters related to it.	10	10
Contents	Demonstrate Radar system and calculate parameter: Pulsed Radar. CW Radar. FM CW Radar. MTI Radar.		
Method of Assessment	External Practical.		

RGPV (DIPLOMA WING)BHOPAL		OBECURRICULUMFOR THE COURSE		FORMAT-3	Sheet No. 1/5
Branch	Electronics & Tele-communication			Semester	6
Course Code		Course Name	Microwave and Radar Engineering		
Course Outcome 4	Discover recent trends in Radar Engineering.			Teach Hrs	Marks
Learning Outcome 15	Describe recent applications of Radar.			10	10
Contents	Radar application in Modern Equipment: Vehicle speed detection using Radar, Self driving cars, Vehicle parking assistance system, Air traffic control system, Weather surveillance Radar.				
Method of Assessment	Internal Theory				

Suggested List of Experiments*:

S.N.	Experiment	CO
1.	Verify the working of microwave components.	CO 603.1
2.	To determine isolations, coupling coefficients and input VSWR's for E and H plane waveguide Tee and Magic Tee junctions.	CO603.1
3.	Study of Directional Couplers (Directivity, insertion loss, coupling factor), Isolators, Circulators.	CO603.1
4.	To plot V-I characteristics of Gunn Diode/Tunnel Diode/varacter Diode.	CO603.2
5.	Use microwave test bench setup to test the performance of klystron tube.	CO603.3
6.	Demonstration of microwave measuring equipment.	
7.	Calculate the value of VSWR, Power, Frequency for given microwave Load.	CO603.4
8.	To study Radar System.	CO603.5
9.	Use Doppler Radar to detect the maximum range.	CO603.5
10.	Determine the velocity of moving object using Radar system,.	CO603.5
11.	Use freeware/open source simulation tools to measure the performance of Microwave component and tubes.	CO603.3
12.	Use freeware/open source simulation tools to measure the performance of RADAR.	CO603.5

*Ten experiments in a semester as per the discretion of the subject teacher.

Major Equipment/Materials:

1.	Microwave Test Bench -X Band (Klystron based) / or any other equivalent, Klystron Power Supply, Klystron tube with Klystron mounts, Frequency meter, Variable attenuator, Detector mount, Wave guide stand, SWR meter and oscilloscope, E Plane Tee, H Plane Tee and Magic Tee Isolator and Circulator, Directional Coupler, Horn Antenna proto type
2.	Microwave test bench -X Band (GUNN Diode based)/ or any other equivalent, Gunn oscillator, Gun power supply, PIN modulator, Isolator, Frequency meter, Variable attenuator, Detector mount, Wave guide stands, SWR Meter. Cables and accessories
3.	RADAR Trainer (X Band)/or any other equivalent Technical Specifications: Transmitting Frequency : 10 GHz, Output Power : 10 to 15mW, Operating Voltage : 8 6V or adjustable, Antenna : Horn and parabolic dish with LNA and mounting IF Output : Audio range, Power Supply : 230V 10%, 50Fiz

Reference Books/Web Portals:

S.N.	Title	Author
1	Microwave and Radar Engineering	Kulkarni,Umesh Publication.
2	Microwave devices and circuit.	Liao samuelY,PHILearning,New Delhi.
3	Radar Engineering	G. S. N. Raju,I. K. International
4	Electronic Communication Systems	George Kennedy,McGraw Hill Education.
5	Microwave engineering	Das Annapurna & Das S. K. Mc. Graw Hill, New Delhi, (Latest edition)
6	Microwave Devices & Circuits engineering	Liao Samuel Y. PHI Learning, New Delhi, (Latest edition)
7	Microwave & RADAR Engineering	Gautam A. K. S K Kataria Publications, New Delhi, (Latest edition)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code		CO Code	LO Code	Format No. 4
						E	0	3	6	0		1	
COURSE NAME	Microwave and Radar Engineering												
CO Description	Identify various microwave components.												
LO Description	Describe Microwave and various parameters related to it.												
SCHEME OF STUDY													
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks						
LO-01	Introduction to Microwave Microwave Frequency bands, Properties of microwave, General Applications of Microwaves, Advantages and limitations of Microwaves. Scattering parameters(S-parameters) Insertion loss, attenuation, VSWR, Return loss.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others							

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-01	End Semester Theory Exam	Student will be asked to (and/or): 1. Explain the properties of microwave. 2. List the advantages and disadvantages of microwave? 3. Explain S-parameter and its use in microwave. 4. Explain different losses in microwave devices.	10	Question paper, Rating scale	External

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code		CO Code	LO Code	Format No. 4
						E	0	3	6	0	1	2	
COURSE NAME	Microwave and Radar Engineering												
CO Description	Identify various microwave components.												
LO Description	Illustrate microwave passive components.												
SCHEME OF STUDY													
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks						
LO-02	Microwave Passive components: Waveguide Microwave Junction: <ul style="list-style-type: none"> - H-Plane TEE, E-Plane TEE, Magic TEE with their S-parameters matrix and its applications (With simple numerical). - Rat Race Junction. - Directional Coupler with S parameter matrix for two port directional coupler (With simple numerical).. Power Divider, Corners, Bends, Twists, Attenuator, Resistive card, Ferrite rod, Twisted waveguide, <ul style="list-style-type: none"> - Circulator and Isolators, and Resonator. 	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others.							

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-02	End Semester Theory Exam	<p>Student will be asked to(and/or):</p> <ol style="list-style-type: none"> 1. Define passive components of microwave. 2. Compare Waveguide Microwave Junction. 3. Write names of microwave components with advantages, disadvantages and applications. 4. Explain function of directional coupler. 5. Calculate return loss for given directional coupler using S-matrix. 6. Calculate the value of S parameter matrix for given TEE. 	10	Question paper, Rating scale	External

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code			CO Code	LO Code	Format No. 4
						E	0	3	6	0		1	3	
COURSE NAME	Microwave and Radar Engineering													
CO Description	Identify various microwave components.													
LO Description	Verify the working of microwave passive components.													
SCHEME OF STUDY														
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks							
LO-03	Waveguide Microwave junction (E-PLANE TEE,H-PLANE TEE, Magic TEE) Directional coupler, Resistive card, Isolator etc.	Lab demonstration, hands on practice, lab assignments,	<ul style="list-style-type: none"> Teacher with support from lab staff will demonstrate the procedure of lab experiments. Student will conduct lab assignment based on these experiments. 	-	10	Components: power supply(adaptor, battery etc.) connecting wires, Lab manual, charts, experimental trainer instruments,								

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-03	Practical test in laboratory	Student will be asked to 1. Study of waveguide microwave junction. 2. Verify the working of microwave passive components. 3. Calculate power loss, coupling factor, forward power for given two port directional coupler.	10	Rubrics/Rating scale	External
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

RGPV (Diploma Wing) Bhopal	SCHEME FOR LEARNING OUTCOME	Branch Code			Course Code		CO Code	LO Code	Format No. 4
		<i>E</i>	<i>0</i>	<i>3</i>	<i>6</i>	<i>0</i>	<i>2</i>	<i>4</i>	

COURSE NAME	Microwave and Radar Engineering
CO Description	Classify different active microwave components.
LO Description	Illustrate microwave solid state devices.

SCHEME OF STUDY

S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs	Pract. /Tut Hrs.	LRs Required	Remarks
LO-04	Microwave Active components: Principle, working and application of: PIN diodes, Tunnel diode, Varactor diodes. Avalanche Transit Time devices: IMPATT Diode, TRAPATT diodes. Gunn Diodes: Principle, RWH Theory, Characteristics.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others	

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-04	End Semester Theory Exam	Student will be asked to (and/or): 1. Describe with relevant circuit diagram the working of given microwave diode. 2. Explain TED device and working of Gunn Diode. 3. Compare working of avalanche transit time devices.	10	Rubrics/Rating scale	External
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code			CO Code	LO Code	Format No. 4
						E	0	3	6	0		2	5	
COURSE NAME	Microwave and Radar Engineering													
CO Description	Classify different active microwave components .													
LO Description	Verify the working of microwave solid state devices.													
SCHEME OF STUDY														
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach h Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks							
LO-05	Plot the characteristic of following solid state devices: Tunnel diode, PIN Diode, Varacter Diode, Gunn Diode etc.	Lab demonstration, hands on practice, lab assignments,	<ul style="list-style-type: none"> Teacher with support from lab staff will demonstrate the procedure of lab experiments. Student will conduct lab assignment based on these experiments. 	- -	10	Components: power supply(adaptor, battery etc.) connecting wires, Lab manual, charts, experimental trainer instruments,								

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-05	Practical test in laboratory	Student will be asked to (and/or): 1. Verify the working of given microwave diode. 2. Plot V-I characteristics for given microwave diode.	10	Question paper + Rating scale.	External
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code			CO Code	LO Code	Format No. 4
						E	O	3	6	O		3	6	
COURSE NAME	Microwave and Radar Engineering													
CO Description	Compare various microwave tubes and microwave measuring equipments.													
LO Description	Explain principle and working of microwave tubes.													
SCHEME OF STUDY														
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs.	Pract. / Tut Hrs.	LRs Required	Remarks							
LO-06	High Frequency limitations of Conventional tubes. Principle of operation, Schematic diagram, Performance characteristics and applications of Microwave Tubes: Two cavity Klystron Reflex Klystron Travelling wave Tube(TWT) Magnetrons: Structure of Cavity magnetron, Working principle, application.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others								

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-06	End Semester Theory Exam	Student will be asked to(and/or): 1. Describe working principal of microwave tube with relevant sketch. 2. Explain velocity modulation in klystron tube with the help of apple gate diagram. 3. Write application of given microwave tubes. 4. Compare different microwave tube.	10	Question paper , Rating scale	External

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME			Branch Code			Course Code		CO Code	LO Code	Format No. 4
					E	0	3	6	0		3	
COURSE NAME	Microwave and Radar Engineering											
CO Description	Compare various microwave tubes and microwave measuring equipments.											
LO Description	Demonstrate the working and evaluate different parameters for microwave tubes.											
SCHEME OF STUDY												
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach h Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks					
LO-07	Demonstrate the working of Microwave Tubes: Klystron Tubes TWT Magnetron	Lab demonstration, hands on practice, lab assignments,	<ul style="list-style-type: none"> Teacher with support from lab staff will demonstrate the procedure of lab experiments. Student will conduct lab assignment based on these experiments. 	- -	10	Components: power supply(adaptor, battery etc.) connecting wires, Lab manual, charts, experimental trainer instruments,						

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-07	Practical test in laboratory	Student will be asked to (and/or): 1. Demonstrate the working of microwave tube. 2. Verify different microwave parameters in laboratory.	10	Question paper , Rating scale	Internal
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

RGPV (Diploma Wing) Bhopal	SCHEME FOR LEARNING OUTCOME	Branch Code			Course Code			CO Code	LO Code	Format No. 4
		<i>E</i>	<i>0</i>	<i>3</i>	<i>6</i>	<i>0</i>		<i>3</i>	<i>8</i>	

COURSE NAME	Microwave and Radar Engineering
CO Description	Compare various microwave tubes and microwave measuring equipments.
LO Description	Measure various parameters for microwaves.

SCHEME OF STUDY

S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach H Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks
LO-08	Demonstrate microwave measuring instruments : VSWR meter, Power meter, and Spectrum analyzer. Measurement of Frequency, Power, Losses and VSWR. Insertion loss, attenuation, Return loss.	Lab demonstration, hands on practice, lab assignments,	<ul style="list-style-type: none"> Teacher with support from lab staff will demonstrate the procedure of lab experiments. Student will conduct lab assignment based on these experiments. 	- -	10	Components: power supply(adaptor, battery etc.) connecting wires, Lab manual, charts, experimental trainer instruments,	

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-08	Practical test in laboratory	<p style="text-align: center;">Student will be asked to</p> <ol style="list-style-type: none">1. Demonstrate the working of microwave measuring device.2. Demonstrate the procedure to measure microwave power and losses in laboratory.3. Demonstrate the procedure to measure different microwave parameter with relevant measuring devices.	10	Rubrics, Rating scale	Internal

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME			Branch Code			Course Code		CO Code	LO Code	Format No. 4
					E	O	3	6	0		3	
COURSE NAME	Microwave and Radar Engineering											
CO Description	Compare various microwave tubes and microwave measuring equipments.											
LO Description	Identify recent trends in microwave engineering.											
SCHEME OF STUDY												
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach H Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks					
LO-09	Working Principle of : <ul style="list-style-type: none"> - Microwave imaging. - Microwave oven. Monolithic Microwave IC : Introduction, Selection of material as Substrate Materials, Conductor Materials, Dielectric Materials, Resistive Materials in monolithic microwave ICs. MMIC Fabrication Techniques- Thin and Thick Film IC technology, Hybrid ICs and their comparison.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others						

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-09	Mid Semester Theory Exam/Assignment	Student will be asked to (and/or): 1. Explain the working of microwave imaging. 2. Explain the working of microwave oven. 3. What is MMIC. 4. Explain the procedure to select suitable substrate, conductor, resistive material for MMIC 5. Compare different MMIC fabrication Techniques.	10	Question paper, Rating scale.	Internal

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code			CO Code	LO Code	Format No. 4
						E	0	3	6	0		3	10	
COURSE NAME	Microwave and Radar Engineering													
CO Description	Compare various microwave tubes and microwave measuring equipments.													
LO Description	Relate environmental concerns in microwave engineering.													
SCHEME OF STUDY														
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach H Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks							
LO-10	Microwaves Radiation and its effect on health. Introduction and standard(HERO,HERP,HERF)of Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC)	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others, online resources.								

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-10	Mid Semester Theory Exam/Assignment	Student will be asked to(and/or): 1. Illustrate the effect of microwave radiation on health. 2. Model the Different radiation hazards HERO,HERP,HERF. 3. What is Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC).	10	Question paper , Rating scale.	Internal

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME			Branch Code			Course Code			CO Code	LO Code	Format No. 4
					E	O	3	6	O		4	11	
COURSE NAME	Microwave and Radar Engineering												
CO Description	Categorize the working of different Radar.												
LO Description	Illustrate operation of RADAR.												
SCHEME OF STUDY													
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks						
LO-11	Radar: Introduction, Block Diagram, Basic working Principle. Definition of Range, pulse width, PRF, duty cycle. Radar Frequencies, Millimeter and sub-millimeter waves. Application of Radar. Derivation of Radar Range Equation: Factors affecting Radar range, Prediction of Range Performance, Transmit power, Radar cross-section, Minimum Detectable Signal, Antenna gain. Simple numerical on Radar range equation.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others							

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-11	End Semester Theory Exam	Student will be asked to 1. Draw block diagram of Radar and explain each block. 2. Explain various parameters related to Radar. 3. Drive Radar range equation. 4. Calculate Radar range for given parameters.	10	Rubrics, Rating scale	External

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME			Branch Code			Course Code		CO Code	LO Code	Format No. 4
					E	O	3	6	O		4	
COURSE NAME	Microwave and Radar Engineering											
CO Description	Categorize the working of different Radar.											
LO Description	Define various scanning and Tracking Techniques.											
SCHEME OF STUDY												
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teac h Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks					
LO-12	Scanning Techniques: Horizontal scan Pattern, Elevation/Vertical scans Pattern, Spiral Scanning. Tracking Techniques: Mono-pulse tracking, Conical scan and Sequential lobe switching, Low angle tracking. Working principle with functional block diagram of Pulsed Radar. Radar Display: A- scope and PPI Display.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others						

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-12	End Semester Theory Exam	Student will be asked to (and/or): 1. What is scanning and tracking? 2. Explain various scanning methods? 3. Explain various tracking methods? 4. Explain with sketch diagram the working of pulsed Radar. 5. Define different types of Radar Display.	10	Question paper , Rating scale.	External
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME			Branch Code			Course Code			CO Code	LO Code	Format No. 4
					E	0	3	6	0		4	13	
COURSE NAME	Microwave and Radar Engineering												
CO Description	Categorize the working of different Radar.												
LO Description	Compare different Doppler Radar.												
SCHEME OF STUDY													
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks						
LO-13	Introduction to Doppler effect, concept of blind speed with numerical. Working principle with functional block diagram of: CW Radar. FM CW Radar. MTI Radar. Application and comparison of different Radars.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others							

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-13	End Semester Theory Exam	Student will be asked to (and/or): 1.What is Doppler effect/Doppler shift. 2. Explain with sketch diagram the working of pulsed Radar. 3.Compare Different Radar. 4.Write the application of given Radar.	10	Question paper , Rating scale.	External

ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code			CO Code	LO Code	Format No. 4
						E	0	3	6	0		4	14	
COURSE NAME	Microwave and Radar Engineering													
CO Description	Categorize the working of different Radar.													
LO Description	Demonstrate working of RADAR system and measure parameters related to it.													
SCHEME OF STUDY														
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teach H Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks							
LO-14	Demonstrate Radar system and calculate parameter: Pulsed Radar. CW Radar. FM CW Radar. MTI Radar.	Lab demonstration, hands on practice, lab assignments,	<ul style="list-style-type: none"> Teacher with support from lab staff will demonstrate the procedure of lab experiments. Student will conduct lab assignment based on these experiments. 	- -	10	Components: power supply(adaptor, battery etc.) connecting wires, Lab manual, charts, experimental trainer instruments,								

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-14	Practical test in laboratory	Student will be asked to 1. Demonstrate the working of given Radar. 2. Calculate the velocity of moving object using Radar.	10	Rubrics, Rating scale	External
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

RGPV (Diploma Wing) Bhopal		SCHEME FOR LEARNING OUTCOME				Branch Code			Course Code			CO Code	LO Code	Format No. 4
						E	0	3	6	0		5	15	
COURSE NAME	Microwave and Radar Engineeirng													
CO Description	Discover recent trends in Radar Engineering.													
LO Description	Describe recent applications of Radar.													
SCHEME OF STUDY														
S. No.	Learning Content	Teaching – Learning Method	Description of T-L Process	Teac h Hrs.	Pract. /Tut Hrs.	LRs Required	Remarks							
LO-15	Radar application in Modern Equipment: Vehicle speed detection using Radar, Self driving cars, Vehicle parking assistance system, Air traffic control system, Weather surveillance Radar.	Interactive classroom lecture, PPT, demonstration, quiz, assignments	Teacher will explain the contents and provide handouts to students. Teacher will conduct quiz/ assignments/ tutorial. Teacher will discuss the contents and guide the students to prepare handouts on any one topic. Teacher may conduct quiz/ assignments/ tutorial or ask students to prepare and present any Radar application in class followed by question and answer session.	10	--	Text Books, PPT, Handouts, chalk board, charts. Videos lectures- NPTEL & others, online resources.								

SCHEME OF ASSESSMENT

S. No.	Method of Assessment	Description of Assessment	Maximum Marks	Resources Required	External / Internal
LO-15	Mid Semester Theory Exam/Assignment	Student may be asked to 1. Describe the working of vehicle speed detection system. 2. Describe the working of Air traffic control system.	10	Rubrics, Rating scale	Internal
ADDITIONAL INSTRUCTIONS FOR THE HOD/ FACULTY (IF ANY)					

