

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

**Course Code: EC403**

**Course Name: MICROWAVE & RADAR ENGINEERING**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer any two full questions, each carries 15 marks.*

Marks

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|---|--|--|
| 1 | a) Explain the Transit angle effects in a conventional vacuum tube at microwave frequencies. (5)                               |  |
|   | b) Show that a coaxial re-entrant cavity support infinite number of resonant frequencies (10)                                  |  |
| 2 | a) Draw the Applegate diagram with gap voltage for a reflex klystron (8)   |  |
|   | b) A two cavity klystron amplifier has the following parameters (7)  |  |
|   | $V_0=1000$ $R_0=100$ $K\Omega$ $I_0=30$ $mA$ $f=5$ $GHz$   |  |
|   | Gap spacing in either cavity $d=1$ $mm$ , spacing between the two cavities $L=5$ $cm$<br>shunt impedance $R_{sh}=50$ $K\Omega$ |  |
|   | a) Find the input gap voltage to give maximum voltage $V_2$  |  |
|   | b) voltage gain , neglecting the beam loading in the output cavity   |  |
|   | c) Find the efficiency of the amplifier, neglecting beam loading.  |  |
| 3 | a) What are Cavity Resonators? Derive the equation for resonant frequency for a rectangular cavity resonator (5)               |  |
|   | b) Draw the structure of 8 cavity magnetron and explain its bunching process. (10)   |  |

**PART B**

*Answer any two full questions, each carries 15 marks.*

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|---|---|--|
| 4 | a) Explain the various types of slow wave structures. (5)   |  |
|   | b) A helix travelling wave tube operates at 4 GHz, under a beam voltage of 10 KV and beams current of 500mA. If the helix is $25\Omega$ and interaction length is 20cm, find the gain parameter. (10)                         |  |
| 5 | a) Define the S matrix of a two port network. Represent the logical variables used mathematically and with the aid of a figure. (5)   |  |
|   | b) Based on the principle of working list the different types of wave meters used for measurement of microwave frequency. With a diagram explain the method of measurement of frequency with any one type of wave meter. (10) |  |

- 6 a) Determine the coupling, directivity and isolation (in dBs) of a lossless directional coupler carrying the following: Incident power: 40mW, power at the coupling port: 10mW, and power at the decoupled port: 0.1mW. (5)
- b) Derive the expression for axial electric field in the TWT. (10)

**PART C**

*Answer any two full questions, each carries 20 marks.*

- 7 a) Compare the peak power levels achieved by microwave diodes (5)
- b) A typical n-type GaAs Gunn diode has the following parameters .Threshold field  $E_{th}=2800\text{V/cm}$ , Applied field  $E=3200\text{V/cm}$ , Device Length  $L=10\mu\text{m}$ , Doping concentration  $n_0=2\times 10^{14}\text{cm}^{-3}$ , operating frequency  $f=10\text{GHz}$ . (7)
- a) Compute electron drift velocity.
- b) Calculate current density
- c) Estimate negative electron mobility
- c) What are the main assumptions made in power frequency limitations and what are the power frequency limitations of a microwave transistor? (8)
- 8 a) List the difference between microwave transistors and TEDs. (5)
- b) With neat diagram explain series and parallel loading in tunnel diode. (7)
- c) Describe the Ridley -Watkins -Hilsum theory and derive the condition for negative resistance. (8)
- 9 a) What are the different geometries of microwave power transistor and their figure of merit (5)
- b) Explain with neat diagram, the working of CW radar with non zero IF. (7)
- c) (i) Show that how the tunnel diode can be utilized as bistable, astable, monostable circuits. (4)
- (ii) A tunnel diode can realize a negative resistance amplifier? Justify your answer (4)

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